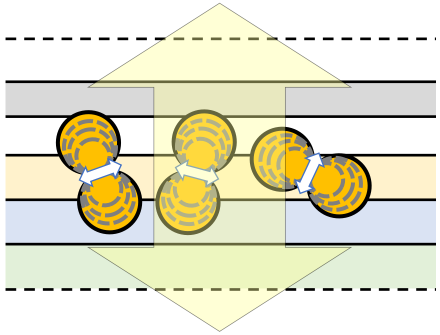
External Light Source-Transmission Reflection Coefficient and Field Distribution

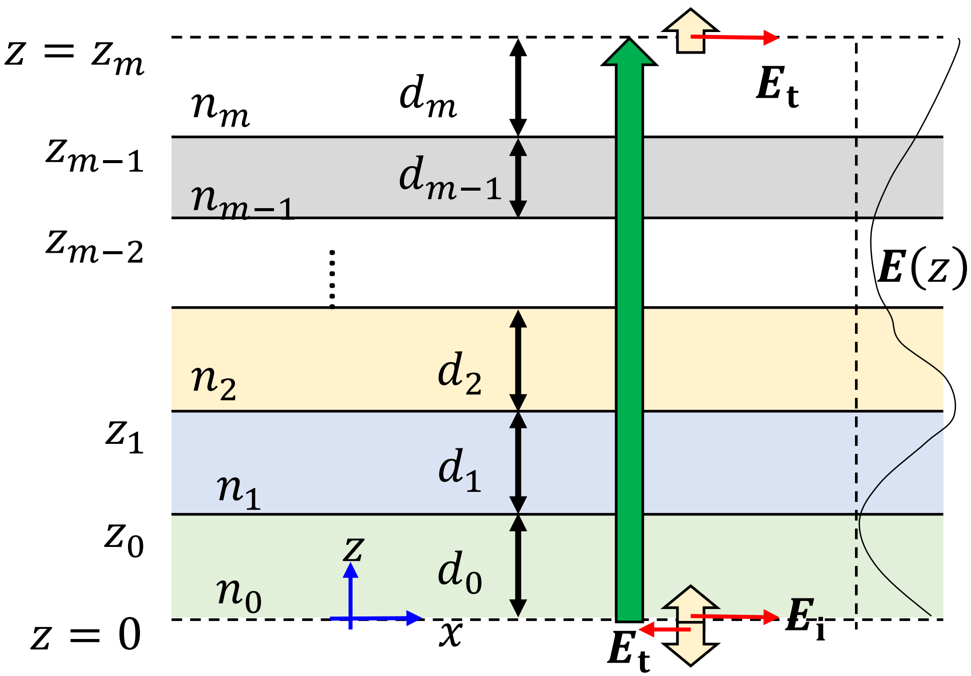
-rtauCmd.pyc

Author: Wei-Kai Lee



Objective

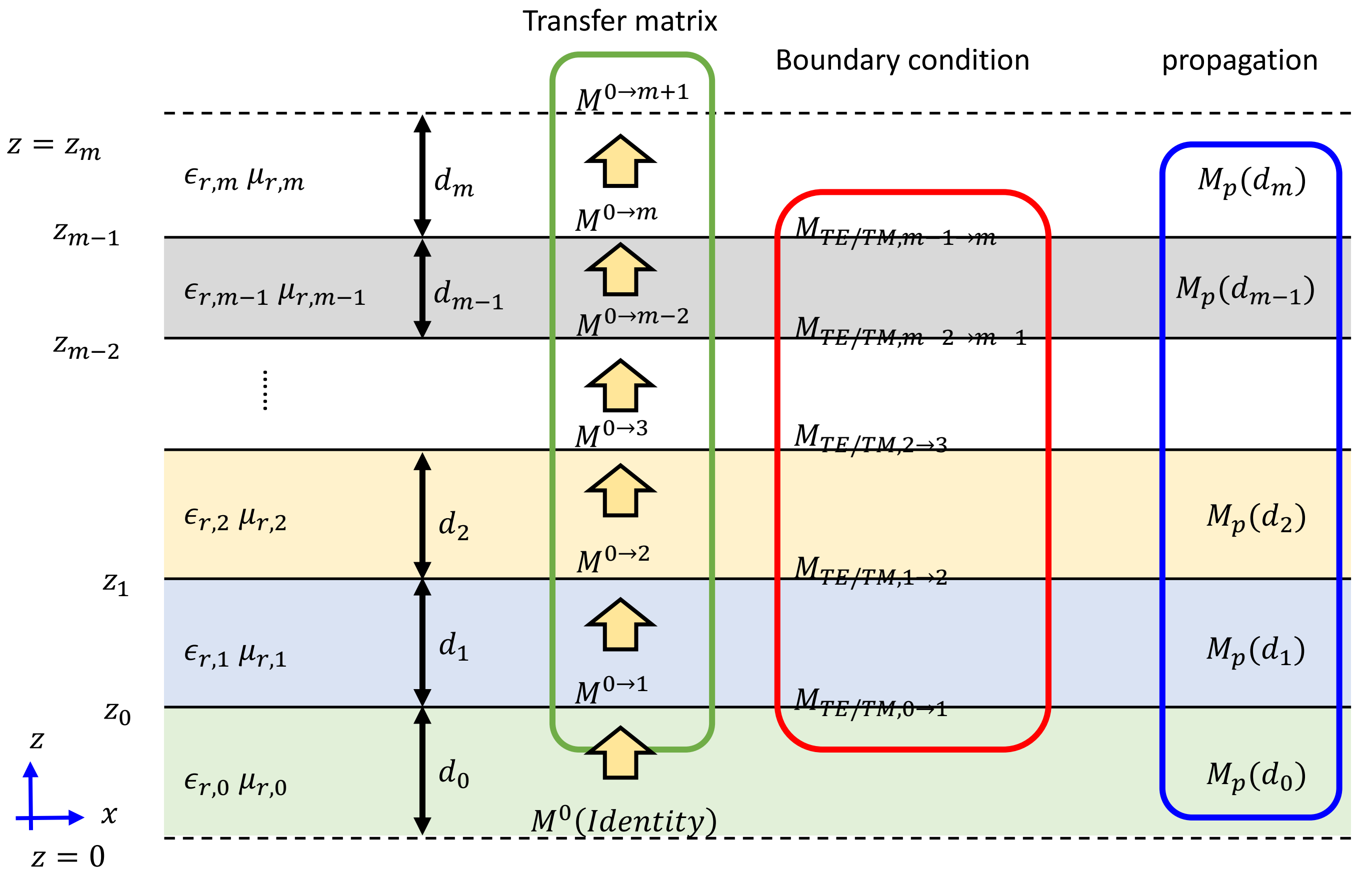
- This program calculates the reflection coefficients and transmission coefficients of the electric field of each mode in a coherent stacking layer and also calculates the field distribution along z axis.



$$\tau = \frac{E_t}{E_i}$$

$$\gamma = \frac{E_r}{E_i}$$

Theory-Transfer Matrix Method (TMM)



$$M^{0\to m} = M_p(d_m)M_{m-1\to m}\, M_p(d_{m-1}) \ldots M_p(d_2)M_{1\to 2}\, M_p(d_1)M_{0\to 1}\, M_p(d_0)$$

Theory-Transfer Matrix Method (TMM)

$$M^{0\to m} = M_p(d_m)M_{m-1\to m}\,M_p(d_{m-1}) \ldots M_p(d_2)M_{1\to 2}\,M_p(d_1)M_{0\to 1}\,M_p(d_0)$$

$$M_p(d_i) = \begin{bmatrix} \exp(ik_{z,1}z) & 0 & 0 & 0 \\ 0 & \exp(ik_{z,2}z) & 0 & 0 \\ 0 & 0 & \exp(ik_{z,3}z) & 0 \\ 0 & 0 & 0 & \exp(ik_{z,4}z) \end{bmatrix}$$

$M_{m-1\to m}$ can be calculate from the boundary conditions

$$\hat{z}\times\boldsymbol{E}_j(z_j) = \hat{z}\times\boldsymbol{E}_{j+1}(z_j)$$
$$\hat{z}\times\boldsymbol{H}_j(z_j) = \hat{z}\times\boldsymbol{H}_{j+1}(z_j)$$

Theory-Transfer Matrix Method (TMM)

$$M^{0\to m} = M_p(d_m)M_{m-1\to m}\,M_p(d_{m-1})\,\ldots M_p(d_2)M_{1\to 2}\,M_p(d_1)M_{0\to 1}\,M_p(d_0)$$

the unit vectors of the electric field of a plane wave

$$\boxed{\boldsymbol{E}(z)} = \boxed{a}\boxed{\boldsymbol{e_1}}exp\left(i\boxed{k_{z,1}}z\right) + \boxed{b}\boxed{\boldsymbol{e_2}}exp\left(i\boxed{k_{z,2}}z\right) + \boxed{c}\boxed{\boldsymbol{e_3}}exp\left(i\boxed{k_{z,3}}z\right) + \boxed{d}\boxed{\boldsymbol{e_4}}exp\left(i\boxed{k_{z,4}}z\right)$$

Total electric field

the z components of a plane wave.

the coefficients of the plane wave

$$\begin{bmatrix} a(z_m) \\ b(z_m) \\ c(z_m) \\ d(z_m) \end{bmatrix} = M^{0\to m} \begin{bmatrix} a(0) \\ b(0) \\ c(0) \\ d(0) \end{bmatrix}$$

Theory-Transfer Matrix Method (TMM)

If the incidence is mode 1:

$$\begin{bmatrix} \tau_{11} \\ \tau_{21} \\ 0 \\ 0 \end{bmatrix} = M^{0\to m} \begin{bmatrix} 1 \\ 0 \\ \gamma_{31} \\ \gamma_{32} \end{bmatrix}$$

$$\begin{pmatrix} \gamma_{31} \\ \gamma_{32} \end{pmatrix} = \frac{-1}{M_{33}^{0\to m} M_{44}^{0\to m} - M_{34}^{0\to m} M_{43}^{0\to m}} \begin{pmatrix} M_{44}^{0\to m} & -M_{34}^{0\to m} \\ -M_{43}^{0\to m} & M_{33}^{0\to m} \end{pmatrix} \begin{pmatrix} M_{31}^{0\to m} \\ M_{41}^{0\to m} \end{pmatrix}$$

$$\begin{pmatrix} \tau_{11} \\ \tau_{21} \end{pmatrix} = \begin{pmatrix} M_{11}^{0\to m} \\ M_{21}^{0\to m} \end{pmatrix} + \begin{pmatrix} M_{13}^{0\to m} & -M_{14}^{0\to m} \\ -M_{23}^{0\to m} & M_{24}^{0\to m} \end{pmatrix} \begin{pmatrix} \gamma_{31} \\ \gamma_{32} \end{pmatrix}$$

How to execute γ and τ calculator

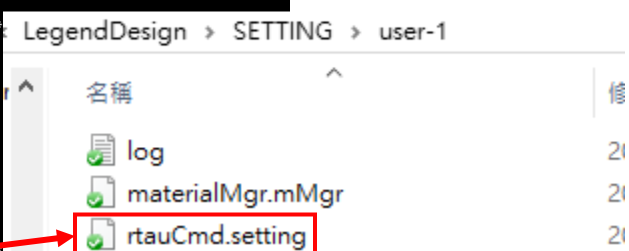
python: windows
python3: mac, linux

```
python rtauCmd.pyc
```

Execution file

```
>>> Please insert username : user-1
Now reading nk file (..\..\..\sim\mater
Now reading nk file (..\..\..\sim\mater
Now reading nk file (..\..\..\sim\material n k/B3PYMPM_isotropic.mat)
Now reading nk file (..\..\..\sim\material n k/B3PYMPM_uniaxial.mat)
Now reading nk file (..\..\..\sim\material n k/B3PYMPM_uniaxial.mat)
Now reading spectrum file (..\..\..\sim\material PL/cbp_irppy3.spc)
Now reading dipole orientation factor file (..\..\..\sim\material eta/cbp_irppy3.eta)
Successfully reading materialMgr.mMgr
Now printing the information stored in the material manager...
[A]: er                  [N]3TPYMB(#2)
                         [N]B3PYMPM_isotropic(#1)
                         [N]B3PYMPM_uniaxial(#1)
                         [N]B3PYMPM(#1)
--------------------------------------------------------------------------------
[A]: Fluorescence        [N]cbp_irppy3(#1)
--------------------------------------------------------------------------------
[A]: Phosphorescence     /*Empty*/
--------------------------------------------------------------------------------
[A]: DOF                 [N]cbp_irppy3(#1)
--------------------------------------------------------------------------------
[A]: wavelengthunitstr   [N]nm(#1)
                         [N]um(#1)
                         [N]m(#1)
--------------------------------------------------------------------------------
[A]: Attribute/ [N]: Name(# of data)


----------------------------------------------------------------------------------------------------
Start running GOODLAB anisotropic simulator ver1.0 Sun Apr 12 10:30:37 2020
----------------------------------------------------------------------------------------------------


*************************************  GOODLAB SIMULATOR Info  ******************
Optical Planar OLED Simulation Tool/Console interface
Anisotropic Version 1.0
Author : Wei-Kai Lee
Publication Date : 2019/03/15

Copyright(c) 2019 Wei-Kai Lee. All right reserved.
[1] Calculate the reflection and transmission coefficient of layered structure(s)
[2] Manage the result of structure file.
[3] Manage structure files and structure file lists.
*************************************  GOODLAB SIMULATOR Info  ******************

rtau Setting is not built in ../../SETTING/user-1
Now saving the default rtau setting.
```

Type user name



Construct setting file automatically.

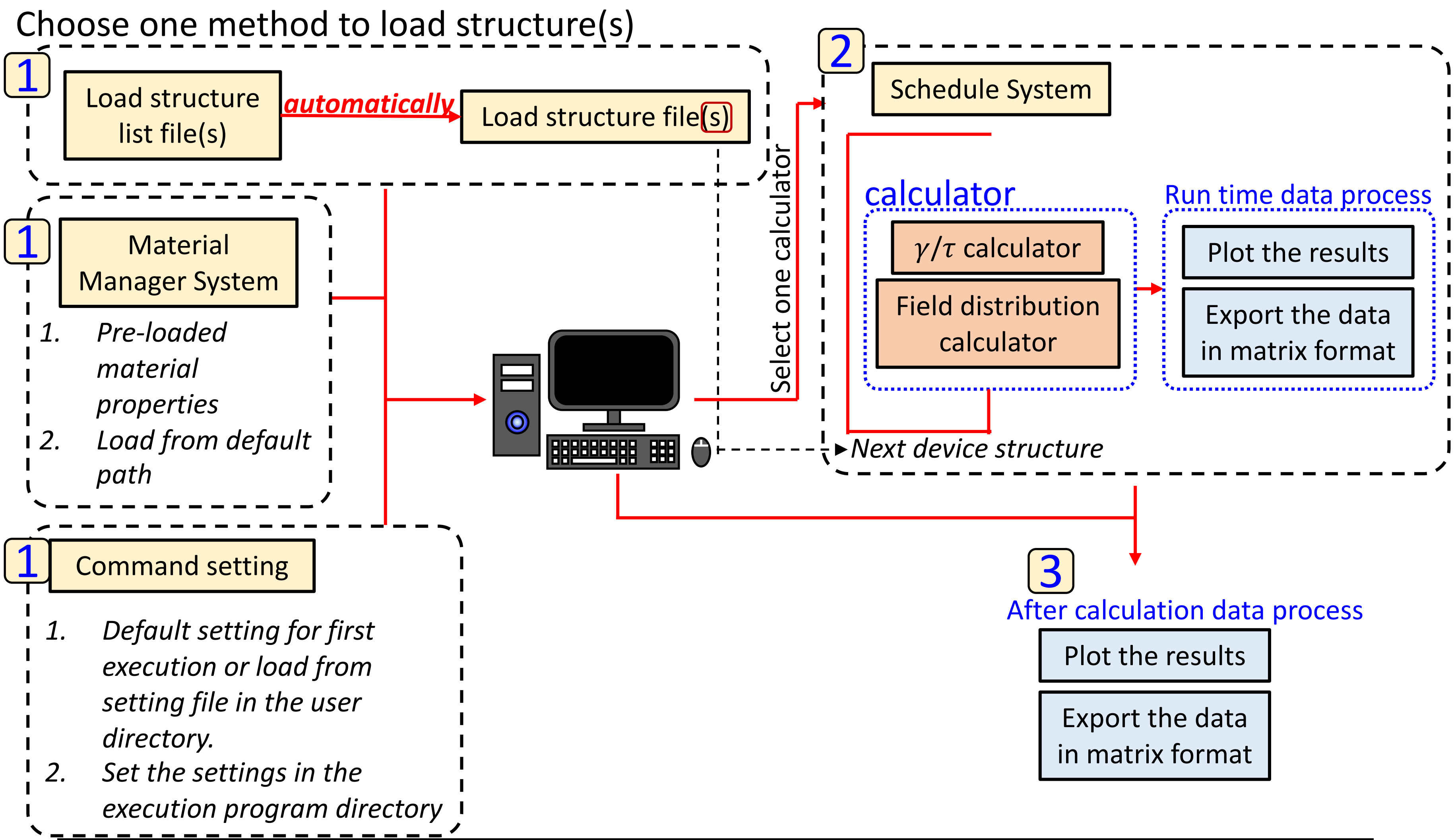
Help

```
User Control Command
========================================
1. Settting Command:
changeUser          exit

Material Manager Command
========================================
1. Settting Command:
printMgr            saveMgr

Structure/Structure List Command
========================================
1. Structure List Command:
ReadStructListPath   ReadStructListName
SaveStructListPath   SaveStructListName
readStructList       saveStructList

2. Structure Command:
ReadStructPath       ReadStructName
SaveFilePath         SaveFileName
readStruct           deleteStruct

3. Print Information Command:
printStructInfo      printStructSettingInfo
printListInfo

4. Result Command:
ResultFilePath       ResultFileName
deleteResult
save_run_time_result_Bool
resetSN
```

Help

```
Transmission/reflection coefficient Command
========================================
1. Settting Command:
SettingFilePath       SettingFileName
setDefaultSetting     printrtauInfo
loadrtauSETTING       savertauSETTING

2. Transmission/reflection coeffcients in kxky domain:
kxko                  kyko                  Wavelength             ----Parameter
IncidenceWaveDirection ----Parameter
runrtaukxky           plotrtauvsWVkxky
plotrtauContourkxky   writeMatrixkxky

3. Transmission/reflection coeffcients in angle:
Theta                 Phi                   Wavelength             ----Parameter
IncidenceWaveDirection ----Parameter
runrtauAngle          plotrtauvsWVAngle
plotrtauContourAngle writeMatrixAngle

4. Field distribution (z) in kxky:
kxko                  kyko                  Wavelength             z                     ----Parameter
IncidenceWaveDirection ----Parameter
runE_vs_z_kxky        plotEvsZkxky

5. Field distribution (z) in angle:
Theta                 Phi                   Wavelength             z                     ----Parameter
IncidenceWaveDirection ----Parameter
runE_vs_z_Angle       plotrEvsZAngle

6. Plot Bool:
changefigshowBool
plot_EBool            plot_HBool
plot_AbsoluteBool     plot_PhaseBool
plot_Incidence1       plot_Incidence2
plot_Incidence3       plot_Incidence4

7. Run Time Bool:
runtime_write_matrix runtime_plotvsWV
runtime_plotvsContour
runtime_plotEvsZ
```

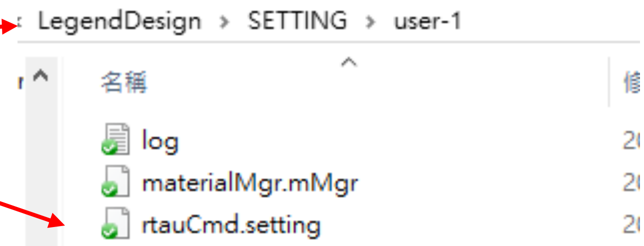
Calculating Workflow



Default Setting

Print setting

```
<rtauCmd> printrtauInfo
Setting file path : ../../SETTING/user-1
Setting file name : rtauCmd.setting
Figure Show Bool : True
Wavelength (nm) : 380.00000:10.00000:780.00000
Theta (degree) : 0.00000:1.00000:90.00000
Phi (degree) : 0.0
kx/ko : -1.00000:0.10000:1.00000
ky/ko : -1.00000:0.10000:1.00000
z : -10.00000:1.00000:10.00000
Incidence Direction   : TOP
Plot field absolute bool : True
Plot field phase bool    : True
Plot electric field bool : True
Plot magnetic field bool : True
Plot incidence 1 bool    : True
Plot incidence 2 bool    : True
Plot incidence 3 bool    : True
Plot incidence 4 bool    : True
Run time bool :
Save run-time-result bool   : True
Run-time-write-matrix bool  : False
Run-time-plot-VS-wavelength bool    : False
Run-time-plot-rtau-vs-Angle or -kxky bool : False
Run-time-plot-contour bool  : False
Run-time-plot-E-vs-Z bool   : False
```



All the setting would **automatically** saved into the setting file when the program **finished**. The user can set the setting at first or share the setting files with others.

Setting

```
Wavelength (nm) : 380.00000:10.00000:780.00000
```

The wavelength of the incident light. The format of the wavelength is the same as in the parameter scan. (i.e. value/start:space:end/(value1,value2,value3))

Wavelength setting method

```
<rtauCmd> help Wavelength
Set wavelength (nm).
[Usage] Wavelength [wavelength] - single value, start:spacing:end, (v1,v2,v3,v4)
```

Setting

```
Theta (degree) : 0.00000:1.00000:90.00000
Phi (degree) : 0.0
```

The angle of the incident wave.

Angle setting method

```
<rtauCmd> help Theta
Set theta (degree).
[Usage] Theta [theta] - single value, start:spacing:end, (v1,v2,v3,v4)

<rtauCmd> help Phi
Set phi (degree).
[Usage] Phi [phi] - single value, start:spacing:end, (v1,v2,v3,v4)
```

```
kx/ko : -1.00000:0.10000:1.00000
ky/ko : -1.00000:0.10000:1.00000
```

The tangential components of the incident wave.

kx/ko and ky/ko setting method

```
<rtauCmd> help kxko
Set kx/ko.
[Usage] kxko [kxko] - single value, start:spacing:end, (v1,v2,v3,v4)

<rtauCmd> help kyko
Set ky/ko.
[Usage] kyko [kyko] - single value, start:spacing:end, (v1,v2,v3,v4)
```

Only one would be used in a calculation.

Setting

```
z : -10.00000:1.00000:10.00000
```

Simulation position. Only valid when calculating the field distribution.

z setting method

```
<rtauCmd> help z
Set z.
[Usage] z [z] - single value, start:spacing:end, (v1,v2,v3,v4)
```

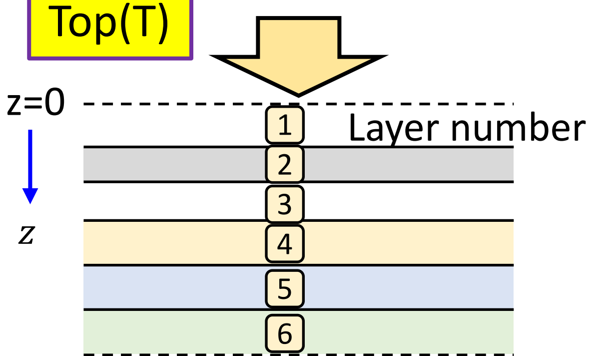
```
Incidence Direction    : TOP
```

The incidence direction

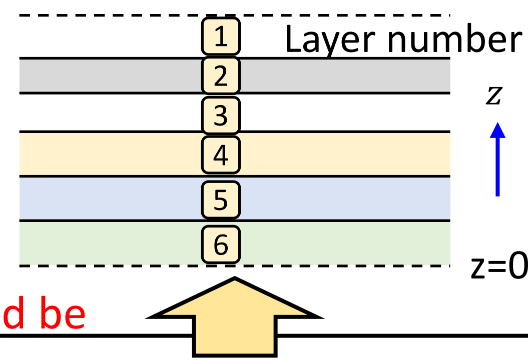
Incidence direction setting method

```
<rtauCmd> help IncidenceWaveDirection
Set the direction of the incidence wave.
[Usage] IncidenceWaveDirection [TOP(T)/BOTTOM(B)]
```

Top(T)



Bottom(B)



The origin and the direction of z would be different for top or bottom incidence.

Plot Setting

```
Plot field absolute bool : True
Plot field phase bool    : True
```

Whether to plot the absolute value/phase or not.

```
Plot electric field bool : True
Plot magnetic field bool : True
```

Whether to plot the electric/magnetic field or not.

```
Plot incidence 1 bool    : True
Plot incidence 2 bool    : True
Plot incidence 3 bool    : True
Plot incidence 4 bool    : True
```

Whether to plot the results of the corresponding mode.

For isotropic material,

mode 1 : TE mode propagate toward +z

mode 2 : TM mode propagate toward +z

mode 3 : TE mode propagate toward -z

mode 4 : TM mode propagate toward -z

For isotropic material,

mode 1 : Ordinary wave propagate toward +z

mode 2 : Extraordinary wave propagate toward +z

mode 3 : Ordinary wave propagate toward -z

mode 4 : Extraordinary wave propagate toward -z

Run Time Setting

```
Run time bool :
Save run-time-result bool    : True
```

Whether to save the data in the memory after the calculation. If the user would like to execute plot or other data manipulation commands, the save-run-time-result bool should be “True”. However, the user should notice the memory usage when scanning a lot of parameters.

```
Run-time-write-matrix bool   : False
```

Whether to save the matrix format when calculation.

```
Run-time-plot-VS-wavelength bool     : False
Run-time-plot-rtau-vs-Angle or -kxky bool : False
Run-time-plot-contour bool   : False
```

Whether to plot the γ and τ results when calculation.

```
Run-time-plot-E-vs-Z bool    : False
```

Whether to plot field distribution when calculation.

Calculate γ, τ

MATERIAL	THICKNESS(nm)
1.0	X
1.5	X

```
wavelength(nm) : 480.0:10.0:600.0
```

Calculate γ, τ

Structure file (DBR)

MATERIAL	THICKNESS(nm)
air	X
1.5	100
2.5	60
1.5	100
2.5	60
1.5	100
2.5	60
air	X

wavelength(nm) : 480.0:10.0:600.0

Name	readfilename	readfilepath	savefilename	
#sds1	sfile-1.txt	./Example/structure/DielectricStacking	sfile-1	../..
#sds2	sfile-2.txt	./Example/structure/DielectricStacking	sfile-1	../..

Calculate γ, τ

Structure file (transparent device-1)

MATERIAL	THICKNESS(nm)
air	X
Al	$\boxed{10:5:20}$
LiF	1.000000
B3PYMPM	50
CBP	20.000000
TAPC	20
cito	50
glass	X

scan

```
wavelength(nm) : 450:10:650.0
EML :
    Layerno                 : 5
    Position(nm)            : 10.000000
    ratio                   : 1.000000
    QY                      : 1.000000
    Fluorescence            : cbp_irppy2acac
    DOF                     : cbp_irppy2acac
```

Name	readfilename	readfilepath	savefilename	
#Ts1	sfile-1.txt	./Example/structure/Transparent	sfile-1	../../

Calculate γ, τ

```
>>> changefigshowBool F

>>> save_run_time_result_Bool F

>>> ###################################

*** Unknown syntax: ###################################
>>> ReadStructListPath  ./Example/structure/DielectricStacking

>>> ReadStructListName  structureList-rtauCmd.txt

>>> readStructList

Now reading structure list file ./Example/structure/DielectricStacking\structureList-rtauCmd.txt
  No./Name       filename        savefilename  CommandID  Check                            readfilepath
------------------------------------------------------------------------------------------------------------
     #sds1    sfile-1.txt             sfile-1        0.0      X  ./Example/structure/DielectricStacking  ../../Examp
     #sds2    sfile-2.txt             sfile-1        0.0      X  ./Example/structure/DielectricStacking  ../../Examp


Structure file reading...
----------------------------------------------------------------------------------------------------
Now reading structure file ./Example/structure/DielectricStacking\sfile-1.txt
Now reading structure file ./Example/structure/DielectricStacking\sfile-2.txt
```

Calculate γ, τ

```
>>> printStructInfo

***************************************
Name: #sds1
[#]   Material                    Thickness(nm)
---------------------------------------
[1]   1.0                         X
[2]   1.5                         X

wavelength(nm) : 480.00000:10.00000:600.00000

Device number : 1


***************************************
Name: #sds2
[#]   Material                    Thickness(nm)
---------------------------------------
[1]   air                         X
[2]   1.5                         100.0
[3]   2.5                         60.0
[4]   1.5                         100.0
[5]   2.5                         60.0
[6]   1.5                         100.0
[7]   2.5                         60.0
[8]   air                         X

wavelength(nm) : 480.00000:10.00000:600.00000

Device number : 1
```

No scan parameter: only one device

Calculate γ, τ

```
>>> printrtauInfo

Setting file path : ../../SETTING/user-1
Setting file name : rtauCmd.setting
Figure Show Bool : False
Wavelength (nm) : 380.00000:10.00000:780.00000
Theta (degree) : 0.00000:1.00000:90.00000
Phi (degree) : 0.0
kx/ko : -1.00000:0.10000:1.00000
ky/ko : -1.00000:0.10000:1.00000
z : -10.00000:1.00000:10.00000
Incidence Direction    : TOP
Plot field absolute bool : True
Plot field phase bool    : True
Plot electric field bool : True
Plot magnetic field bool : True
Plot incidence 1 bool    : True
Plot incidence 2 bool    : True
Plot incidence 3 bool    : True
Plot incidence 4 bool    : True
Run time bool :
Save run-time-result bool    : False
Run-time-write-matrix bool   : False
Run-time-plot-VS-wavelength bool     : False
Run-time-plot-rtau-vs-Angle or -kxky bool : False
Run-time-plot-contour bool   : False
Run-time-plot-E-vs-Z bool    : False
```

Calculate γ, τ

Load next structure list.

```
>>> ReadStructListPath  ./Example/structure/Transparent

>>> ReadStructListName  structureList-rtauCmd.txt

>>> readStructList

Now reading structure list file ./Example/structure/Transparent\structureList-rtauCmd.txt
  No./Name       filename        savefilename  CommandID  Check                      readfile
------------------------------------------------------------------------------------------------
      #Ts1     sfile-1.txt             sfile-1        0.0       X   ./Example/structure/Transpa


Structure file reading...
------------------------------------------------------------------------------------------------
Now reading structure file ./Example/structure/Transparent\sfile-1.txt
```

Calculate γ, τ

Now, there are three structures.

```
>>> printStructInfo

****************************************
Name: #sds1
[#]   Material              Thickness(nm)
----------------------------------------
[1]   1.0                   X
[2]   1.5                   X

wavelength(nm) : 480.00000:10.00000:600.00000

Device number : 1


****************************************
Name: #sds2
[#]   Material              Thickness(nm)
----------------------------------------
[1]   air                   X
[2]   1.5                   100.0
[3]   2.5                   60.0
[4]   1.5                   100.0
[5]   2.5                   60.0
[6]   1.5                   100.0
[7]   2.5                   60.0
[8]   air                   X

wavelength(nm) : 480.00000:10.00000:600.00000

Device number : 1
```

```
****************************************
Name: #Ts1
[#]   Material              Thickness(nm)
----------------------------------------
[1]   air                   X
[2]   Al                    10.00000:5.00000:20.00000
[3]   LiF                   1.0
[4]   B3PYMPM               50.0
[5]   CBP                   20.0
[6]   TAPC                  20.0
[7]   cito                  50.0
[8]   glass                 X

wavelength(nm) : 450.00000:10.00000:650.00000

EML   Fluorescence    DOF              Position(nm)   PLQY          Ratio
---------------------------------------------------------------------------
[5]   cbp_irppy2acac  cbp_irppy2acac   10.0           1.0           1.0
Device number : 3
```

scan

Calculate γ, τ

```
>>> Wavelength  500
>>> Theta 0:1:90
>>> Phi 0
>>> runtime_write_matrix F
>>> runtime_plotvsContour F
>>> runtime_plotvsWV F
>>> runtime_plotvsXY T
>>> runrtauAngle
Now running structure (#1/#3) #sds1 ...
|Device-#1/#1|(100%)>>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/0sec(s)
Now running structure (#2/#3) #sds2 ...
|Device-#1/#1|(100%)>>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/0sec(s)
Now running structure (#3/#3) #Ts1 ...
|Device-#3/#3|(100%)>>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/1sec(s)
```

Set incidence wave

Set run-time bool

execute

Progress bar

Calculate γ, τ

```
>>> Wavelength  500:50:600

>>> Theta 0:1:90

>>> Phi 0:10:360

>>> runtime_write_matrix T

>>> runtime_plotvsContour T

>>> runtime_plotvsWV F

>>> runtime_plotvsXY F

>>> runrtauAngle

Now running structure (#1/#3) #sds1 ...
|Device-#1/#1|(100%)>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/16sec(s)
Now running structure (#2/#3) #sds2 ...
|Device-#1/#1|(100%)>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/19sec(s)
Now running structure (#3/#3) #Ts1 ...
|Device-#3/#3|(100%)>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/56sec(s)
```

Set incidence wave

Set run-time bool

execute

Calculate γ, τ

```
>>> Wavelength  380:1:780
>>> Theta (0,30,45,60)
>>> Phi 0
>>> runtime_write_matrix F
>>> runtime_plotvsContour F
>>> runtime_plotvsWV T
>>> runtime_plotvsXY F
>>> runrtauAngle
Now running structure (#1/#3) #sds1 ...
|Device-#1/#1|(100%)>>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/3sec(s)
Now running structure (#2/#3) #sds2 ...
|Device-#1/#1|(100%)>>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/5sec(s)
Now running structure (#3/#3) #Ts1 ...
|Device-#1/#3|(0%)                      |Wavelength 380.0 (nm) is out of material permittivity range!!!
Wavelength 381.0 (nm) is out of material permittivity range!!!
Wavelength 382.0 (nm) is out of material permittivity range!!!
Wavelength 383.0 (nm) is out of material permittivity range!!!
Wavelength 384.0 (nm) is out of material permittivity range!!!
Wavelength 385.0
Wavelength 386.0
```

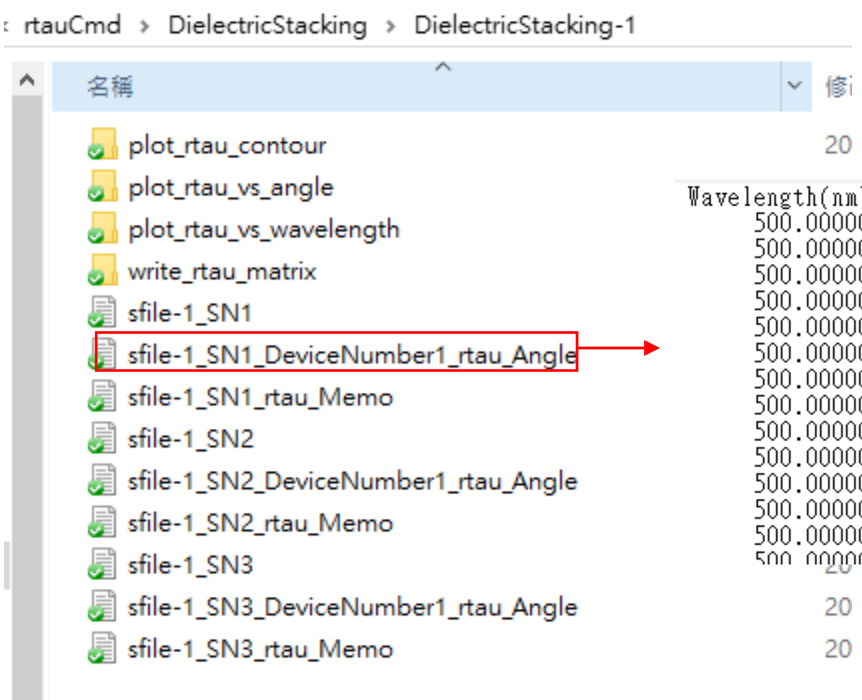
Set incidence wave

Set run-time bool

execute

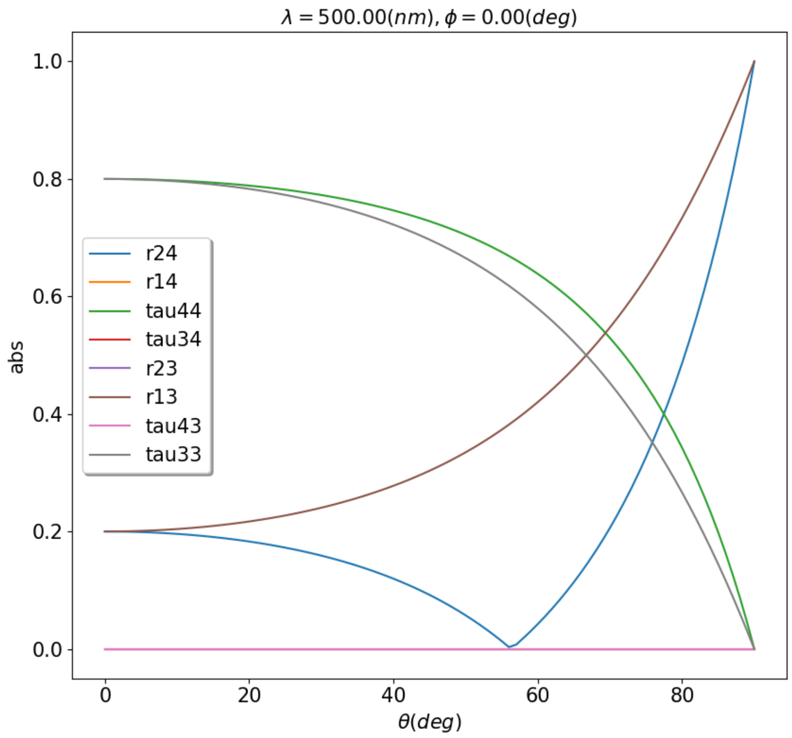
The simulation wavelength is out of the wavelength data in nk file.
The program would automatically remove the out-of-range wavelength.

Data

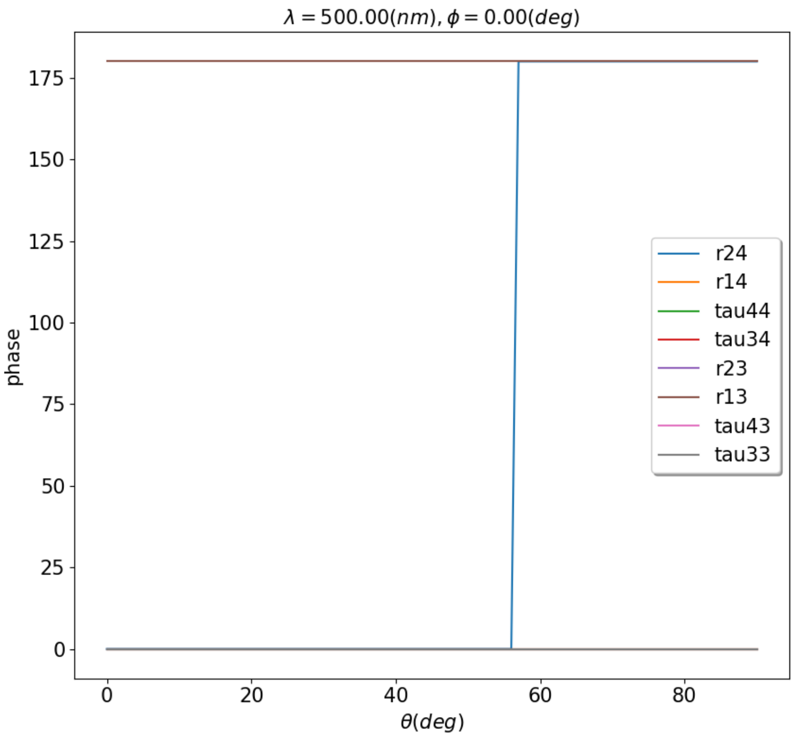


Wavelength(nm)	Theta(deg)	Phi(deg)	ko(1/nm)	Abs(r24)_
500.00000	0.00000	0.00000	0.01257	0.
500.00000	1.00000	0.00000	0.01257	0.
500.00000	2.00000	0.00000	0.01257	0.
500.00000	3.00000	0.00000	0.01257	0.
500.00000	4.00000	0.00000	0.01257	0.
500.00000	5.00000	0.00000	0.01257	0.
500.00000	6.00000	0.00000	0.01257	0.
500.00000	7.00000	0.00000	0.01257	0.
500.00000	8.00000	0.00000	0.01257	0.
500.00000	9.00000	0.00000	0.01257	0.
500.00000	10.00000	0.00000	0.01257	0.
500.00000	11.00000	0.00000	0.01257	0.
500.00000	12.00000	0.00000	0.01257	0.
500.00000	13.00000	0.00000	0.01257	0

Data

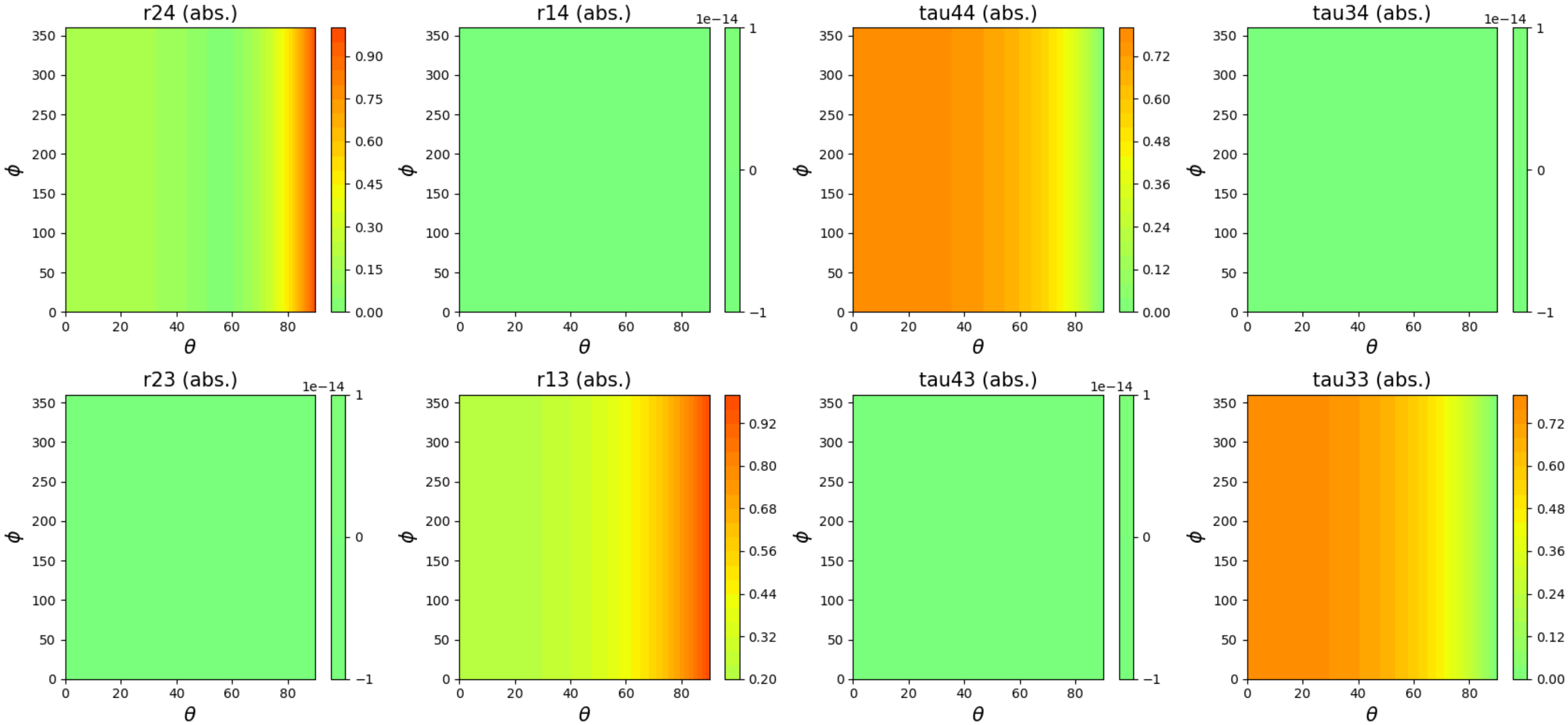


$\lambda = 500.00(nm), \phi = 0.00(deg)$
abs
$\theta(deg)$
1.0
0.8
0.6
0.4
0.2
0.0
0
20
40
60
80
r24
r14
tau44
tau34
r23
r13
tau43
tau33

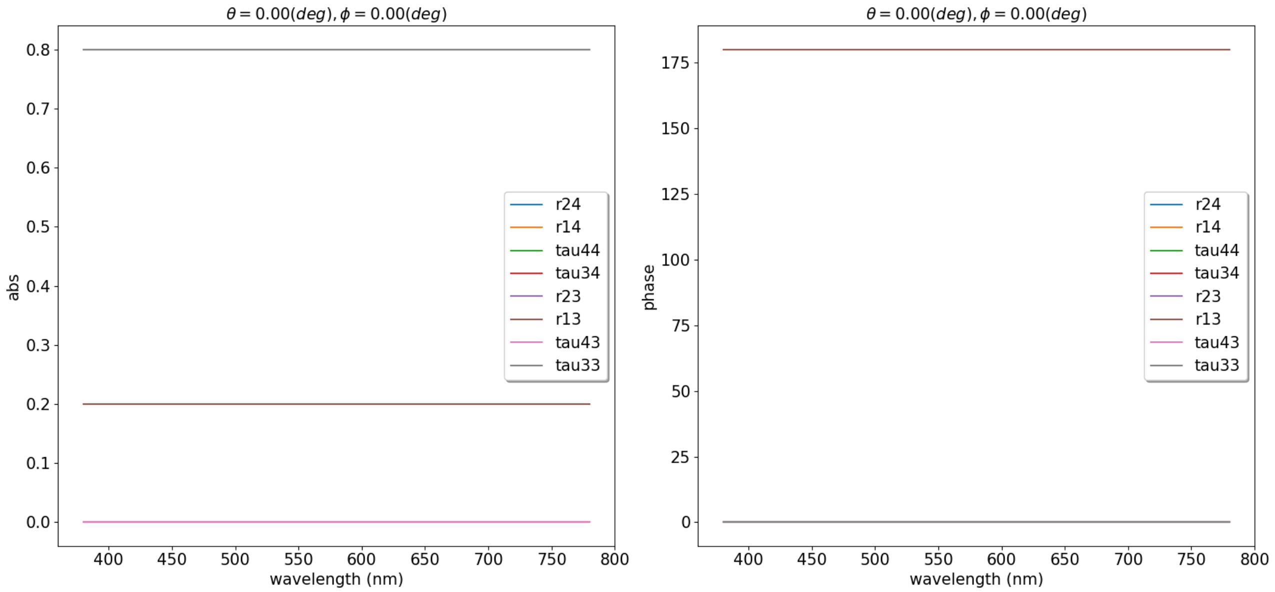


$\lambda = 500.00(nm), \phi = 0.00(deg)$
phase
$\theta(deg)$
175
150
125
100
75
50
25
0
0
20
40
60
80
r24
r14
tau44
tau34
r23
r13
tau43
tau33

Data


r24 (abs.)
r14 (abs.)
tau44 (abs.)
tau34 (abs.)
r23 (abs.)
r13 (abs.)
tau43 (abs.)
tau33 (abs.)
1e−14
θ
ϕ

Data



$\theta = 0.00(deg), \phi = 0.00(deg)$
abs
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
400
450
500
550
600
650
700
750
800
wavelength (nm)
r24
r14
tau44
tau34
r23
r13
tau43
tau33
$\theta = 0.00(deg), \phi = 0.00(deg)$
phase
175
150
125
100
75
50
25
0
400
450
500
550
600
650
700
750
800
wavelength (nm)
r24
r14
tau44
tau34
r23
r13
tau43
tau33

Delete structure

```
>>> deleteStruct
```

Calculate Field Distribution

```
>>> ReadStructListPath  ./Example/structure/DielectricStacking

>>> ReadStructListName  structureList-rtauzCmd.txt

>>> readStructList

Now reading structure list file ./Example/structure/DielectricStacking\structureLi
  No./Name        filename         savefilename  CommandID  Check
--------------------------------------------------------------------------------
     #sds1    sfile-1.txt              sfile-1        0.0       X  ./Example/structu
     #sds2    sfile-2.txt              sfile-1        0.0       X  ./Example/structu


Structure file reading...
--------------------------------------------------------------------------------
Now reading structure file ./Example/structure/DielectricStacking\sfile-1.txt
Now reading structure file ./Example/structure/DielectricStacking\sfile-2.txt
```

```
>>> ReadStructListPath  ./Example/structure/Transparent

>>> ReadStructListName  structureList-rtauzCmd.txt

>>> readStructList

Now reading structure list file ./Example/structure/Transparent\structureList-rtauzCmd.txt
  No./Name        filename         savefilename  CommandID  Check                          readfilepath
---------------------------------------------------------------------------------------------------------
      #Ts1    sfile-1.txt              sfile-1        0.0       X  ./Example/structure/Transparent  ../..


Structure file reading...
--------------------------------------------------------------------------------
Now reading structure file ./Example/structure/Transparent\sfile-1.txt
```

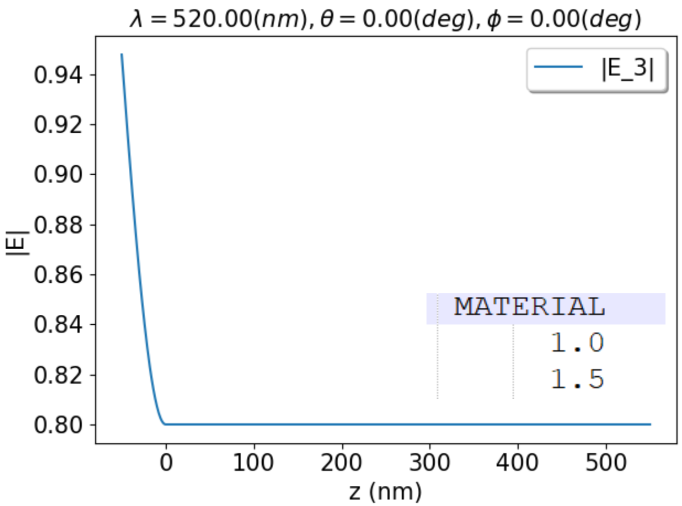
Calculate Field Distribution

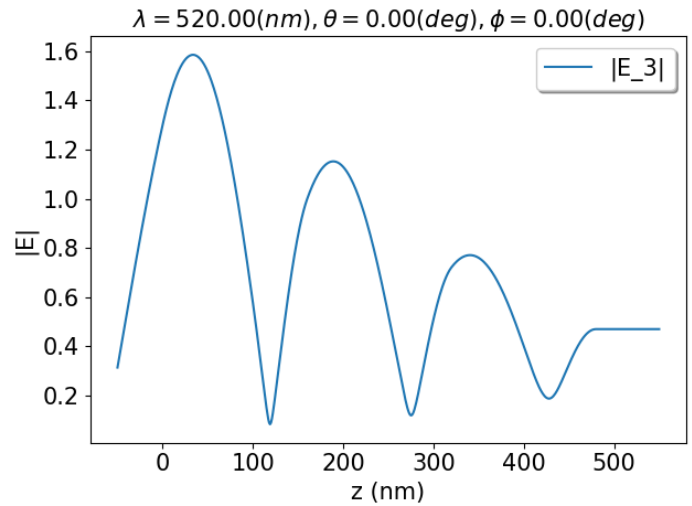
```
>>> Wavelength 520

>>> Theta (0,30,45,60)

>>> Phi   0

>>> z     -50:1:550

>>> runtime_plotEvsZ  T

>>> printrtauInfo

Setting file path : ../../SETTING/user-1
Setting file name : rtauCmd.setting
Figure Show Bool : False
Wavelength (nm) : 520.0
Theta (degree) : (0.0,30.0,45.0,60.0)
Phi (degree) : 0.0
kx/ko : -1.00000:0.10000:1.00000
ky/ko : -1.00000:0.10000:1.00000
z : -50.00000:1.00000:550.00000
Incidence Direction    : TOP
Plot field absolute bool : True
Plot field phase bool     : True
Plot electric field bool : True
Plot magnetic field bool : True
Plot incidence 1 bool     : True
Plot incidence 2 bool     : True
Plot incidence 3 bool     : True
Plot incidence 4 bool     : True
Run time bool :
Save run-time-result bool    : False
Run-time-write-matrix bool   : False
Run-time-plot-VS-wavelength bool     : True
Run-time-plot-rtau-vs-Angle or -kxky bool : False
Run-time-plot-contour bool   : False
Run-time-plot-E-vs-Z bool    : True

>>> runE_vs_z_Angle

Now running structure (#1/#3) #sds1 ...
|Device-#1/#1|(100%)>>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/30sec(s)
Now running structure (#2/#3) #sds2 ...
|Device-#1/#1|(100%)>>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/0min(s)/29sec(s)
Now running structure (#3/#3) #Ts1 ...
|Device-#3/#3|(100%)>>>>>>>>>>>>>>>>>>>>|Elapsed:0day(s)/0hr(s)/1min(s)/28sec(s)
```

Calculate Field Distribution

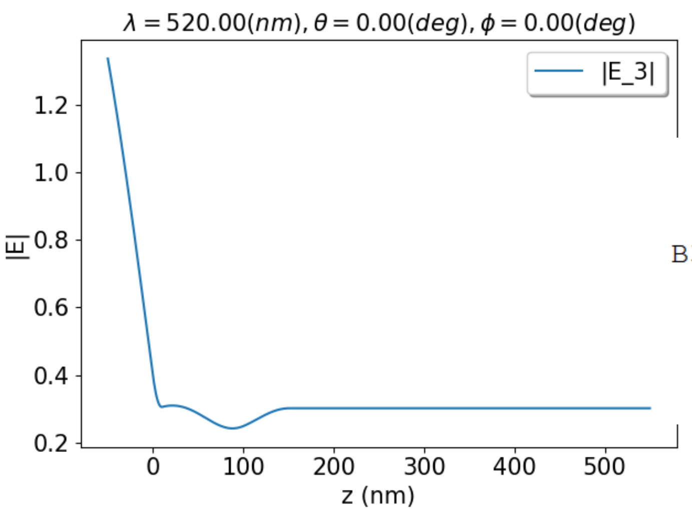
```
>>> runE_vs_z_Angle

Now running structure (#1/#3) #sds1 ...
¦Device-#1/#1¦(100%)>>>>>>>>>>>>>>>>>>>>¦Elapsed:0day(s)/0hr(s)/0min(s)/29sec(s)
Now running structure (#2/#3) #sds2 ...
¦Device-#1/#1¦(100%)>>>>>>>>>>>>>>>>>>>>¦Elapsed:0day(s)/0hr(s)/0min(s)/29sec(s)
Now running structure (#3/#3) #Ts1 ...
¦Device-#3/#3¦(100%)>>>>>>>>>>>>>>>>>>>>¦Elapsed:0day(s)/0hr(s)/1min(s)/26sec(s)
```

Data





air	X
1.5	100
2.5	60
1.5	100
2.5	60
1.5	100
2.5	60
air	X



air	X
Al	10
LiF	1.000000
B3PYMPM	50
CBP	20.000000
TAPC	20
cito	50
glass	X

Exit the material manager system

Exit the material manager system.
*** The material manager system would be automatically saved into the user’s setting directory.

```
>>> exit

------------------------------------------------------------------------------------------
End running GOODLAB anisotropic simulator ver1.0 Sun Apr 12 13:59:49 2020
Elapsed time : 0 day(s)/ 0 hr(s)/ 23 min(s)/ 24.221492767333984 sec(s)
------------------------------------------------------------------------------------------
```