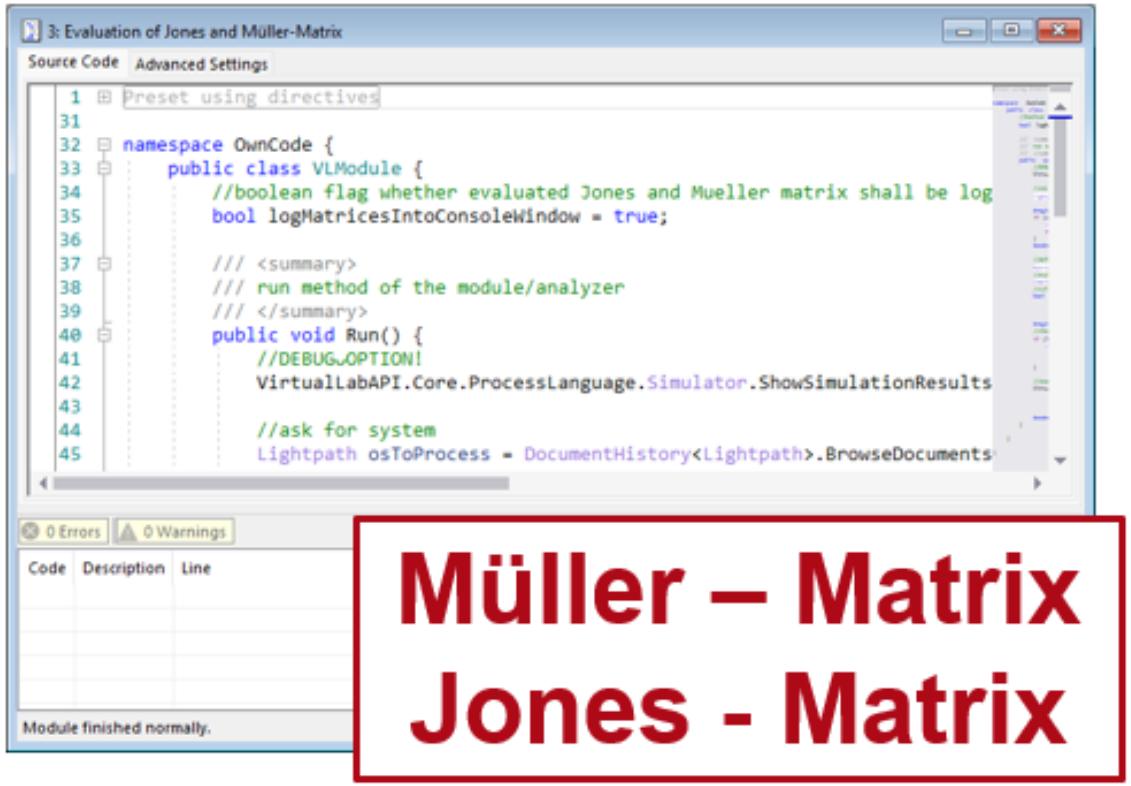
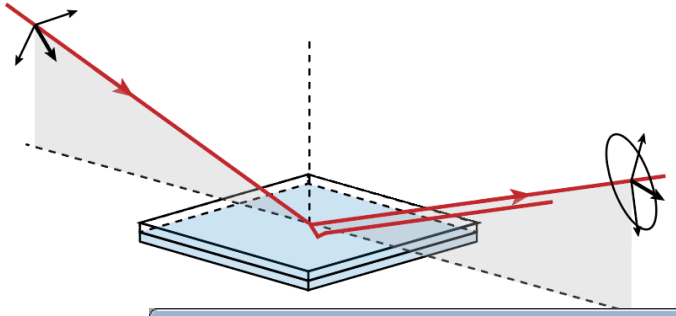
Evaluation of Jones and Müller Matrices

Abstract



This tutorial demonstrates a workflow to calculate Jones and Müller-Matrices for any kind of optical system by using a module.

This Tutorial is about …



3: Evaluation of Jones and Müller-Matrix

Source Code | Advanced Settings

```
1   Preset using directives
31
32  namespace OwnCode {
33      public class VLModule {
34          //boolean flag whether evaluated Jones and Mueller matrix shall be log
35          bool logMatricesIntoConsoleWindow = true;
36
37          /// <summary>
38          /// run method of the module/analyzer
39          /// </summary>
40          public void Run() {
41              //DEBUGₒOPTION!
42              VirtualLabAPI.Core.ProcessLanguage.Simulator.ShowSimulationResults
43
44              //ask for system
45              Lightpath osToProcess = DocumentHistory<Lightpath>.BrowseDocuments
```

0 Errors | 0 Warnings

Code	Description	Line

Module finished normally. Ln 1 Ch 1

Jones Matrix

$0.43017 \cdot \exp(0.17146 \cdot i)$	$9.2619E\text{-}17 \cdot \exp(-2.8637 \cdot i)$
$8.9771E\text{-}17 \cdot \exp(-3.1153 \cdot i)$	$0.75678 \cdot \exp(3.1379 \cdot i)$

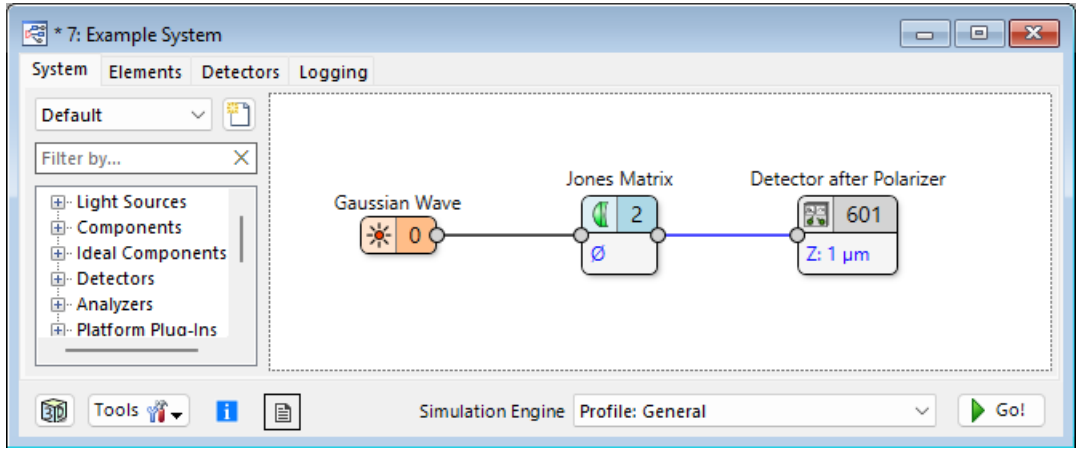
[2025-07-03 08:27:51]

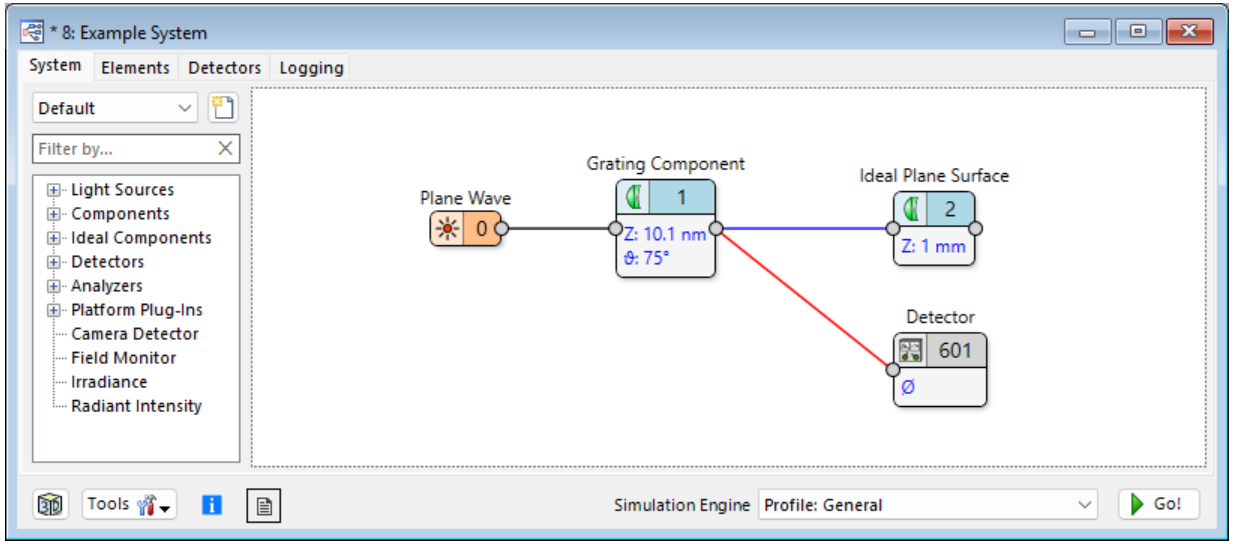
Mueller Matrix

0.37888	-0.19384	2.8291E-17	6.2711E-18
-0.19384	0.37888	-1.0752E-16	2.1979E-18
2.912E-17		-1.0554E-16	-0.32056 -0.056736
-1.3895E-17		2.5069E-17	0.056736 -0.32056

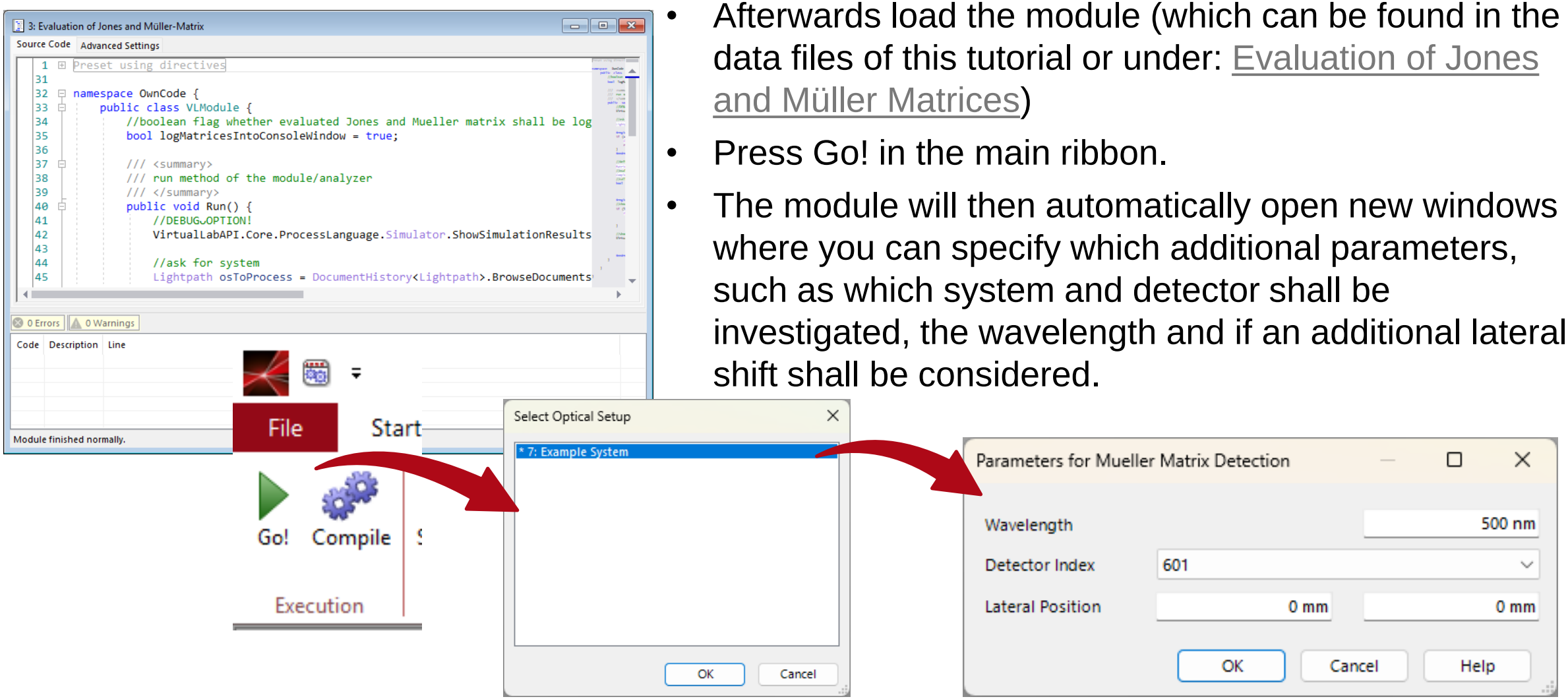
Setting up the System

The presented method works with a variety of different components. Users can setup their systems to be evaluated by ideal components, gratings, layer systems, anisotropic media, etc ….





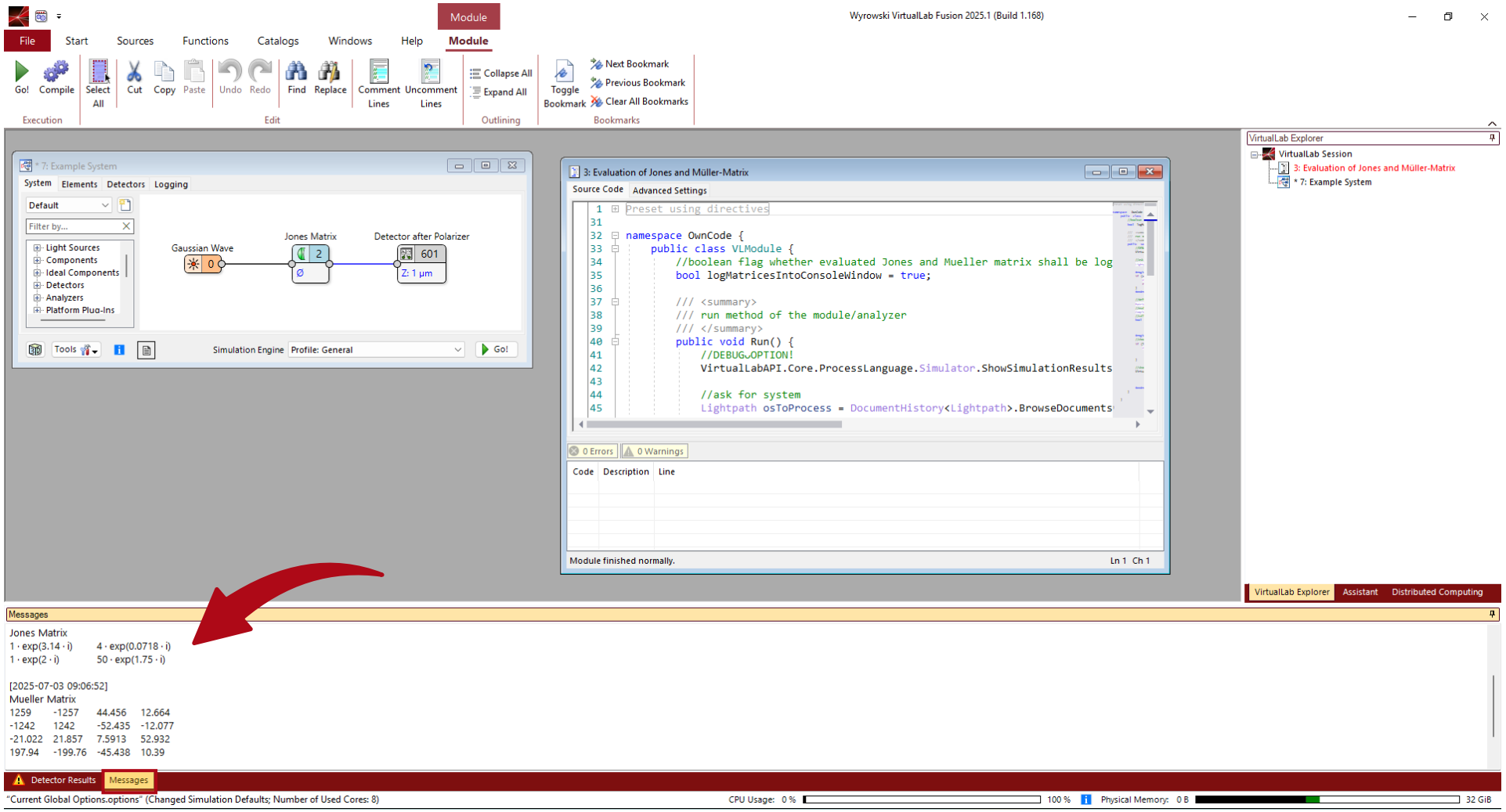
Executing the Module



- Afterwards load the module (which can be found in the data files of this tutorial or under: Evaluation of Jones and Müller Matrices)
- Press Go! in the main ribbon.
- The module will then automatically open new windows where you can specify which additional parameters, such as which system and detector shall be investigated, the wavelength and if an additional lateral shift shall be considered.

Results in the Message Tab

The resulting matrices can then be found in the message tab, commonly placed at the bottom of the screen.

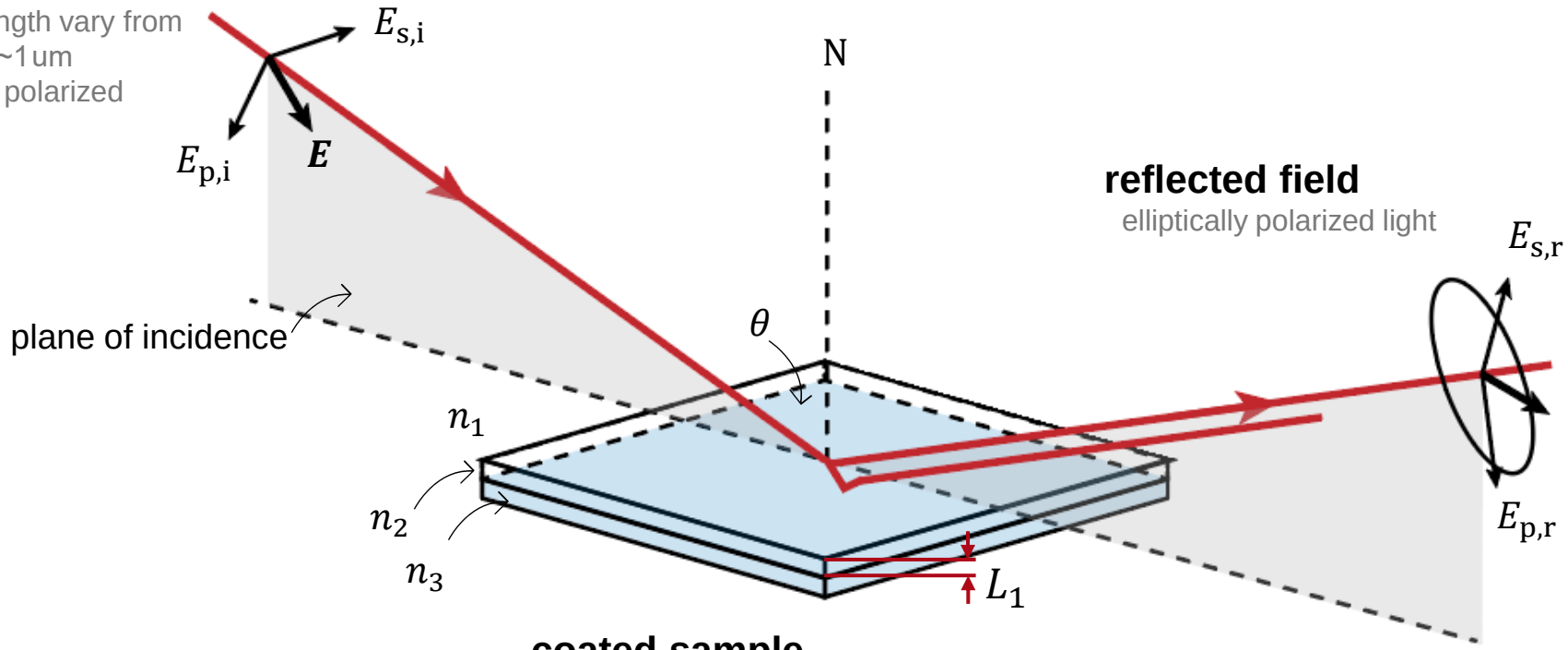


Example – SiO2 Thin-Film

Task Description

input field

- ideal plane wave
- wavelength vary from 200nm~1um
- linearly polarized



reflected field

elliptically polarized light

coated sample

- coating: SiO2 thin film
- thickness L_1 : 10nm±0.1nm
- base material: Si

Task: Evaluate Jones and Müller-matrices for various angles and wavelengths.

Parameters follow from Woollam et al., Proc. SPIE 10294, 1029402 (1999)

Result Overview

$\lambda = 500\,\text{nm}$
$\Theta = 55°$

Jones Matrix

0.43017 · exp(0.17146 · i)	9.2619E-17 · exp(-2.8637 · i)
8.9771E-17 · exp(-3.1153 · i)	0.75678 · exp(3.1379 · i)

[2025-07-03 09:13:44]
Mueller Matrix

0.37888	-0.19384	2.8291E-17	6.2711E-18
-0.19384	0.37888	-1.0752E-16	2.1979E-18
2.912E-17		-1.0554E-16	-0.32056 -0.056736
-1.3895E-17		2.5069E-17	0.056736 -0.32056

$\lambda = 550\,\text{nm}$
$\Theta = 55°$

Jones Matrix

0.41003 · exp(0.15092 · i)	8.624E-17 · exp(-2.8897 · i)
8.8035E-17 · exp(-3.1213 · i)	0.74602 · exp(3.1357 · i)

[2025-07-03 09:14:14]
Mueller Matrix

0.36234	-0.19421	3.0472E-17	5.2786E-18
-0.19421	0.36234	-1.0083E-16	1.8501E-18
2.6423E-17		-9.8001E-17	-0.30214 -0.047757
-1.1696E-17		2.1102E-17	0.047757 -0.30214

$\lambda = 600\,\text{nm}$
$\Theta = 55°$

Jones Matrix

0.39636 · exp(0.13573 · i)	8.1912E-17 · exp(-2.9101 · i)
8.6841E-17 · exp(-3.1251 · i)	0.73859 · exp(3.1348 · i)

[2025-07-03 09:14:40]
Mueller Matrix

0.3513	-0.1942	3.1805E-17	4.5953E-18
-0.1942	0.3513	-9.644E-17	1.6106E-18
2.4614E-17		-9.2966E-17	-0.28978 -0.041575
-1.0182E-17		1.837E-17	0.041575 -0.28978

$\lambda = 500\,\text{nm}$
$\Theta = 75°$

Jones Matrix

0.13638 · exp(1.1986 · i)	1.1347E-16 · exp(-0.23907 · i)
1.7914E-16 · exp(3.0426 · i)	0.88158 · exp(3.1399 · i)

[2025-07-03 09:16:04]
Mueller Matrix

0.39789	-0.37929	1.5923E-16	-2.9496E-26
-0.37929	0.39789	-1.5513E-16	3.0675E-17
-1.0382E-16		9.0633E-17	-0.043536 -0.11207
-4.814E-25		4.7049E-17	0.11207 -0.043536

$\lambda = 550\,\text{nm}$
$\Theta = 75°$

Jones Matrix

0.11112 · exp(1.295 · i)	1.1578E-16 · exp(-0.19788 · i)
1.8034E-16 · exp(3.0577 · i)	0.87585 · exp(3.139 · i)

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Mueller Matrix

0.38973	-0.37738	1.5843E-16	-1.1317E-25
-0.37738	0.38973	-1.5643E-16	2.5653E-17
-1.033E-16		9.5655E-17	-0.026254 -0.093719
-5.469E-26		3.9345E-17	0.093719 -0.026254

$\lambda = 600\,\text{nm}$
$\Theta = 75°$

Jones Matrix

0.094656 · exp(1.3902 · i)	1.1745E-16 · exp(-0.17034 · i)
1.8117E-16 · exp(3.0681 · i)	0.87186 · exp(3.1385 · i)

[2025-07-03 09:17:12]
Mueller Matrix

0.38455	-0.37559	1.5768E-16	1.2788E-25
-0.37559	0.38455	-1.5745E-16	2.2234E-17
-1.0281E-16		9.914E-17	-0.014578 -0.081229
1.3373E-26		3.4102E-17	0.081229 -0.014578

Document Information

Title	Evaluation of Jones and Müller Matrices
Document code	TUT.0459
Publication date	03.07.2025
Required packages	-
Software version	2025.1 (Build 1.172)*
Category	Tutorial
Further reading	• Ellipsometry Analyzer • Variable Angle Spectroscopic Ellipsometry (VASE) Analysis of a SiO2-Coating

** The files attached to this document require the specific version or later.*