

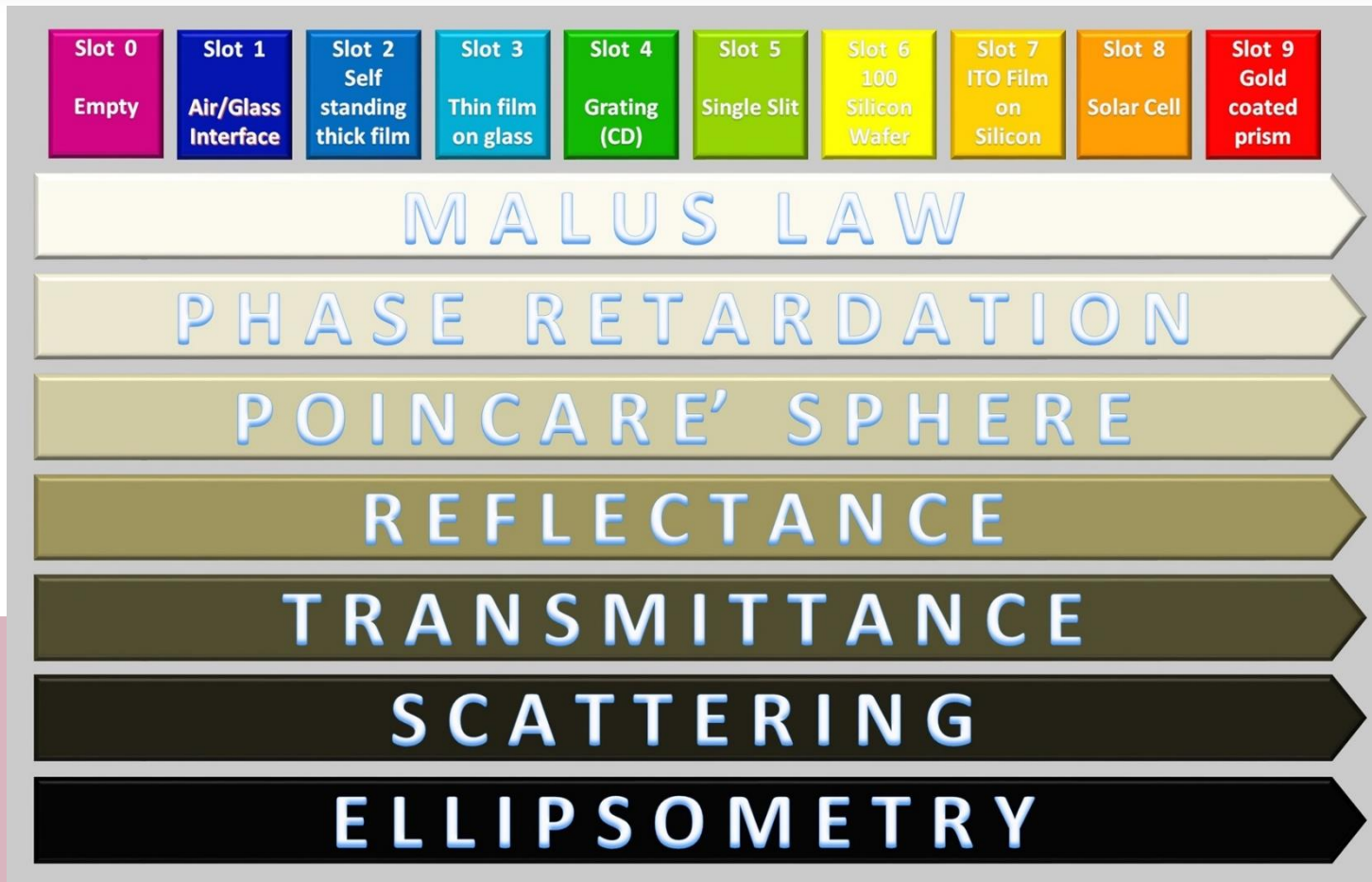


SAPIENZA
UNIVERSITÀ DI ROMA

Description
of the modes
of operation



Modes of operation



- Users can operate the setup in 7 different modes.
- In each mode users can select one sample among some of the 9 standards.



Modes of operation

Fixed Parameters

Fixed Parameters	
Incidence Angle [°]	30
Detection Angle [°]	150
Input Pol Angle [°]	0

Control Parameters	
Output Pol Start Angle [°]	0
Output Pol End Angle [°]	90
Number of Data Points	20
Sample	Empty

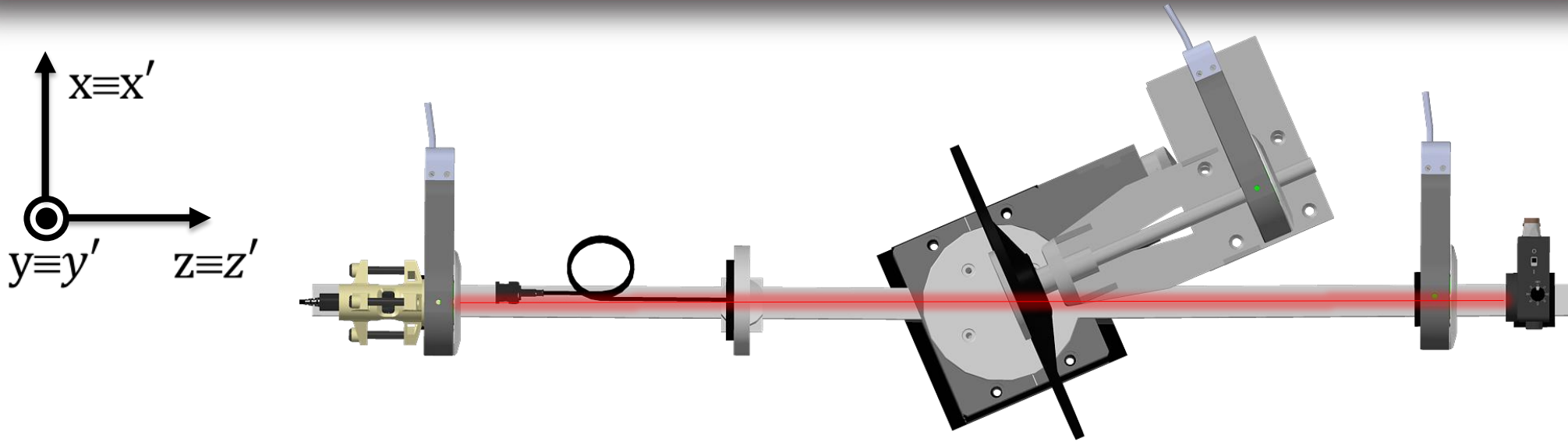
Not yet implemented

Control Parameters

- The modes of operation can be selected by means of a tab menu
- In each mode of operation some parameters are fixed by the system and some control parameters can be varied by the user
- For each control parameter the user fixes a range and a step number



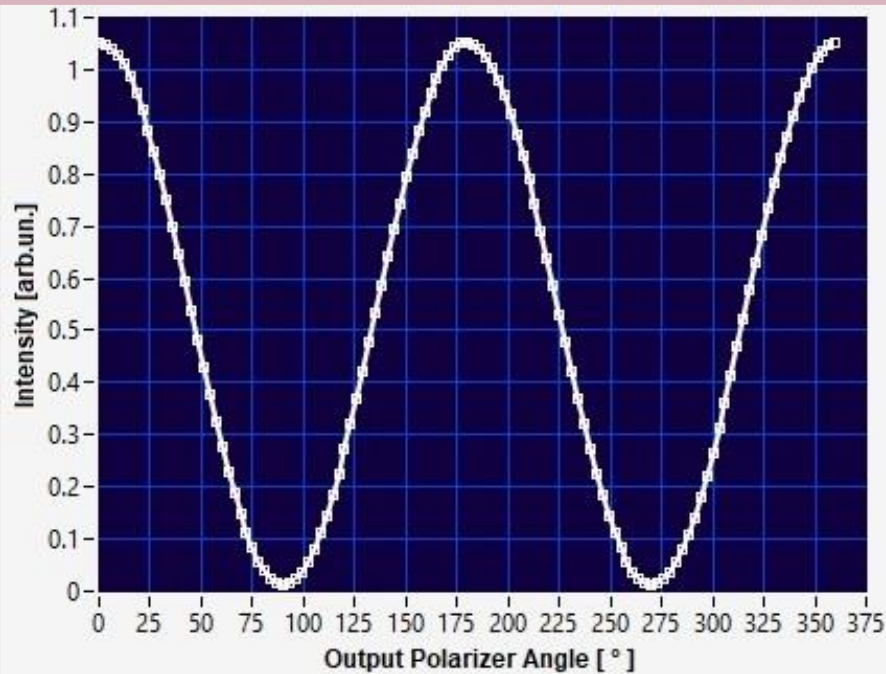
Mode of operation: Malus Law



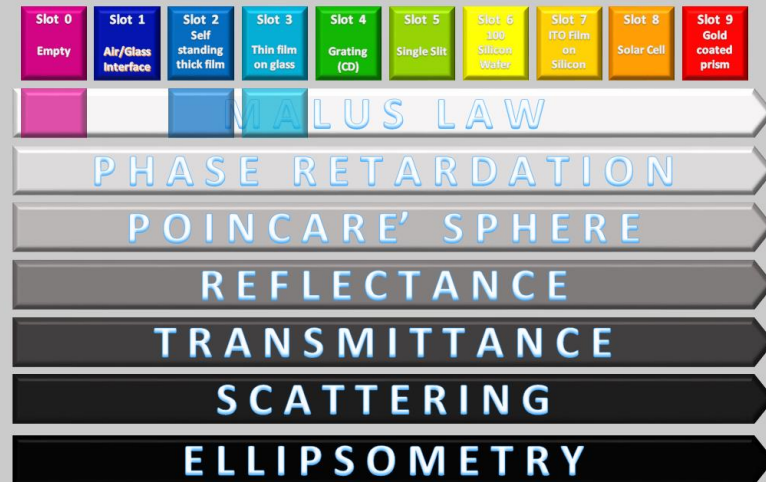
- The illumination and detection arms are aligned ($\theta_i=30^\circ, \theta_d=150^\circ$, fixed)
- The input polarization is set to p ($\varphi_{pol} = 0^\circ$, fixed)
- The user can select the empty slot or 1 out of 2 different samples
- The user can perform a measurement as a function of φ_{an} choosing an interval in the range $\varphi_{an} \in (0^\circ, 360^\circ)$ and with a number of steps
- The Ψ value setting is irrelevant
- The detector measures the power for every value of φ_{an}



Mode of operation: Malus Law



The user can choose the empty slot and one out of 2 samples

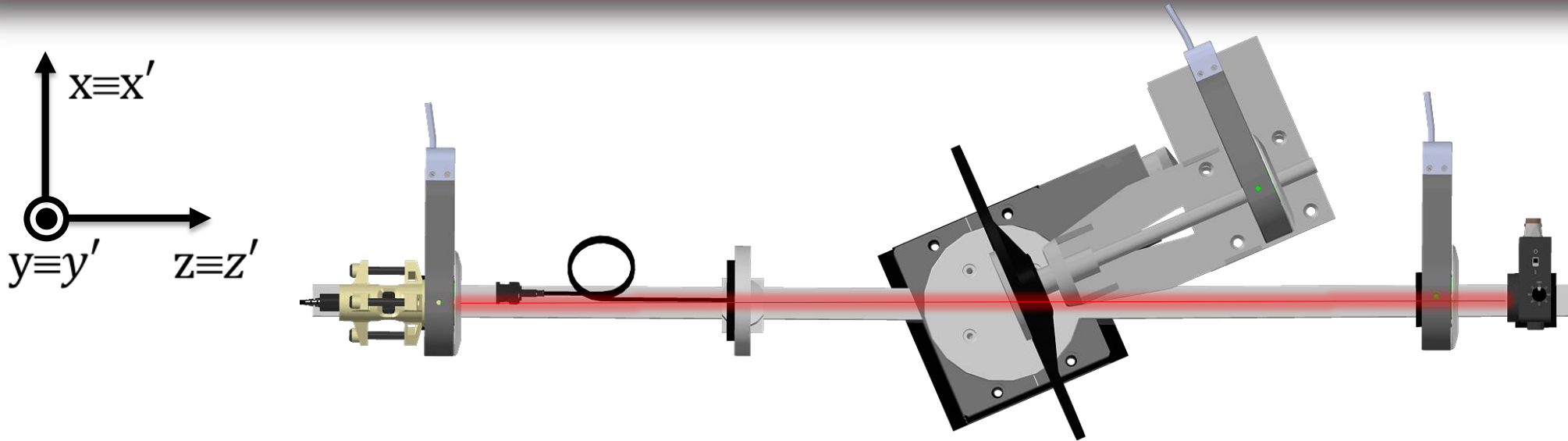


EXAMPLE

- Sample: Empty (Slot 0)
- $\varphi_{an} \in (0^\circ, 360^\circ)$
- 100 steps



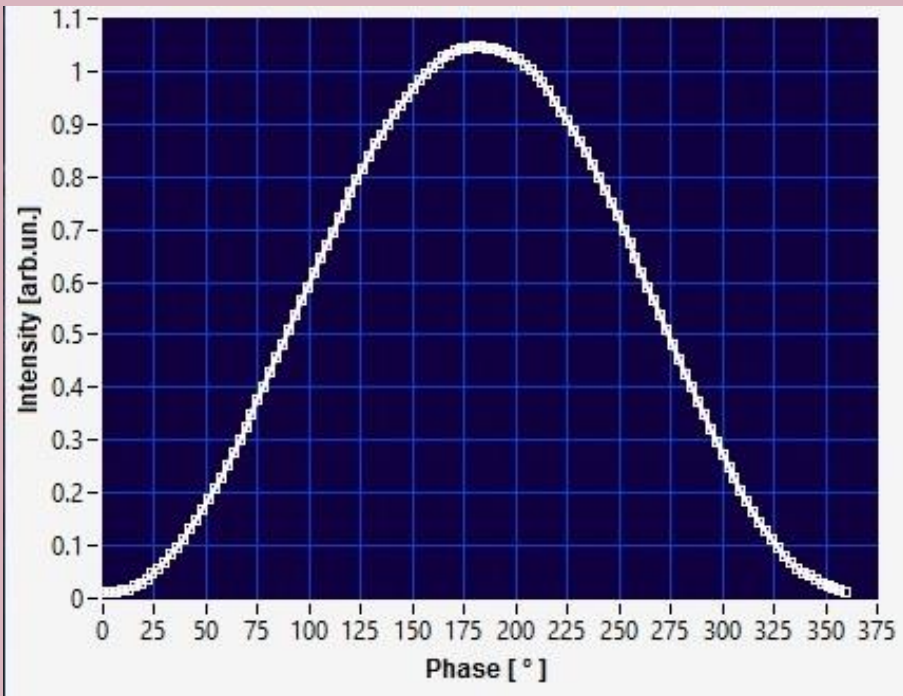
Mode of operation: Phase Retardation



- The illumination and detection arms are aligned ($\theta_i=30^\circ, \theta_d=150^\circ$, fixed)
- The input polarizer is set to -45° ($\varphi_{pol} = -45^\circ$, fixed)
- The output polarizer is set to $+45^\circ$ ($\varphi_{an} = +45^\circ$, fixed)
- The user can select the empty slot and 1 out of 2 different samples
- The user can perform a measurement as a function of Ψ choosing an interval in the range $\Psi \in (0^\circ, 360^\circ)$ and with a number of steps
- The detector measures the power for every value of Ψ



Mode of operation: Phase Retardation



The user can choose the empty slot and one out of 2 samples

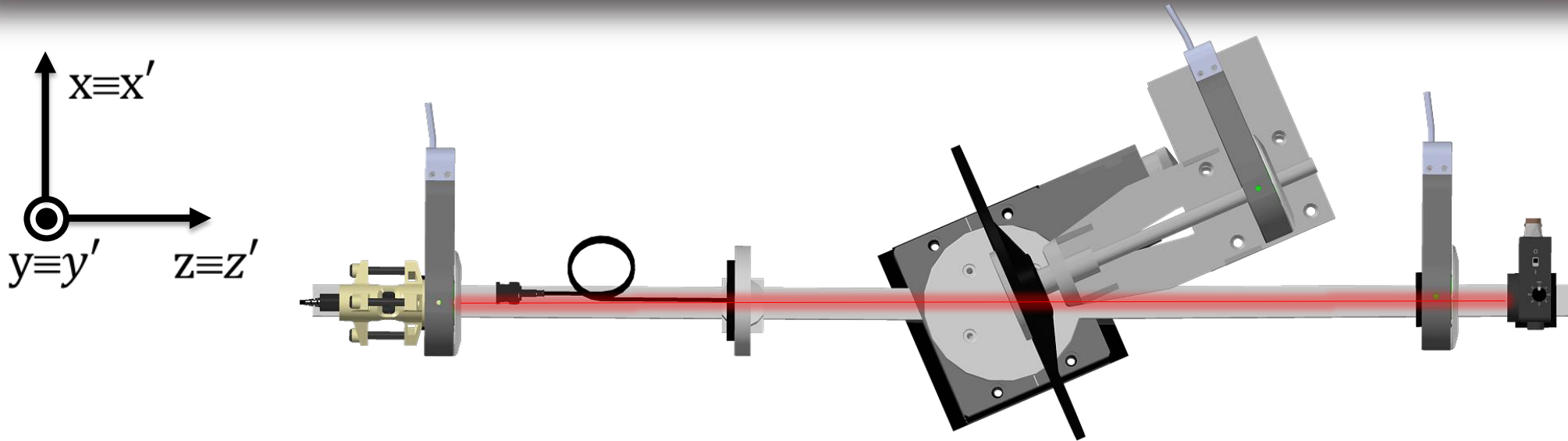
Slot 0 Empty	Slot 1 Air/Glass Interface	Slot 2 Self standing thick film	Slot 3 Thin film on glass	Slot 4 Grating (CD)	Slot 5 Single Silt	Slot 6 100 Silicon Water	Slot 7 ITO Film on Silicon	Slot 8 Solar Cell	Slot 9 Gold coated prism
MALUS LAW									
PHASE	RETARDATION								
POINCARÉ SPHERE									
REFLECTANCE									
TRANSMITTANCE									
SCATTERING									
ELLIPSOMETRY									

EXAMPLE

- Sample: Empty (Slot 0)
- $\Psi \in (0^\circ, 360^\circ)$
- 100 steps



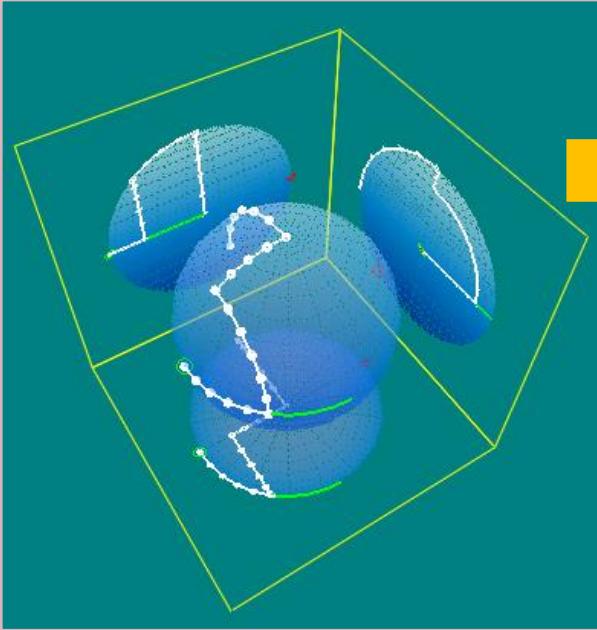
Mode of operation: Poincaré Sphere



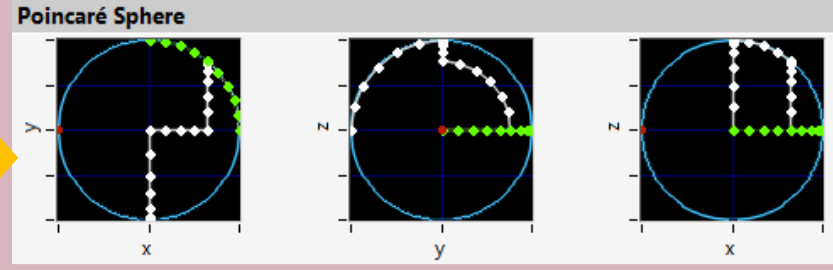
- The illumination and detection arms are aligned ($\theta_i=30^\circ, \theta_d=150^\circ$, fixed)
- The user can select the empty slot and 1 out of 2 different samples
- The user can select a value for φ_{pol}
- The user can select a value for φ_{an}
- The user can select a value for Ψ
- The detector measures the power for every resulting condition



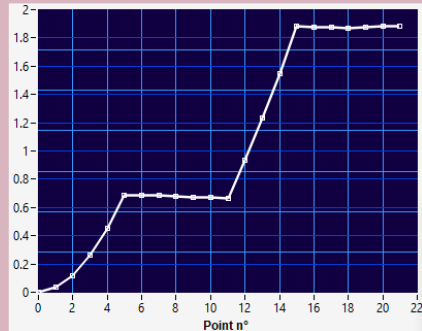
Mode of operation: Poincaré Sphere



The GUI shows only the projections of the Poincaré sphere



The user can choose the empty slot and one out of 2 samples



EXAMPLE

- Sample: Empty (Slot 0)
- $\varphi_{pol} 0^\circ \rightarrow 45^\circ, \Psi 0^\circ \rightarrow 90^\circ,$
 $\varphi_{pol} 45^\circ \rightarrow 90^\circ, \Psi 90^\circ \rightarrow 180^\circ$

Slot 0 Empty	Slot 1 Alr/Glass Interface	Slot 2 Self standing thick film	Slot 3 Thin film on glass	Slot 4 Grating (Cd)	Slot 5 Single Slit	Slot 6 3100 Silicon Water	Slot 7 ITO Film on Silicon	Slot 8 Solar Cell	Slot 9 Gold coated prism
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MALUS LAW

PHASE RETARDATION

POINCARÉ SPHERE

REFLECTANCE

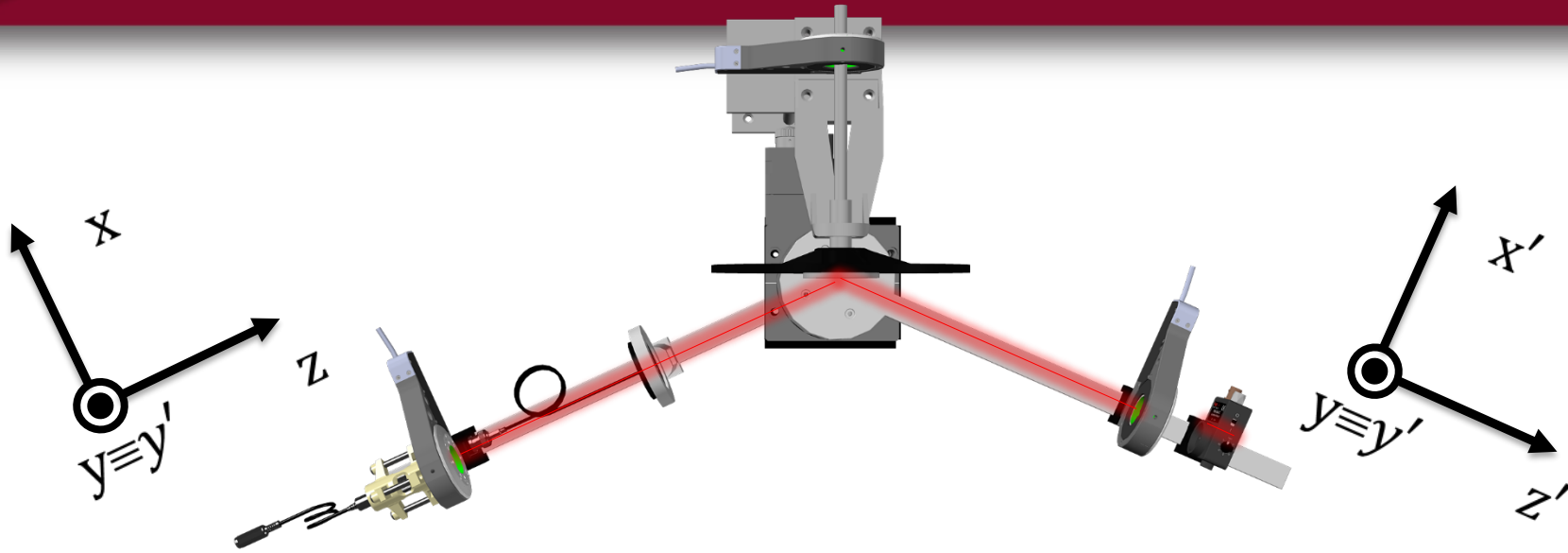
TRANSMITTANCE

SCATTERING

ELLIPSOMETRY



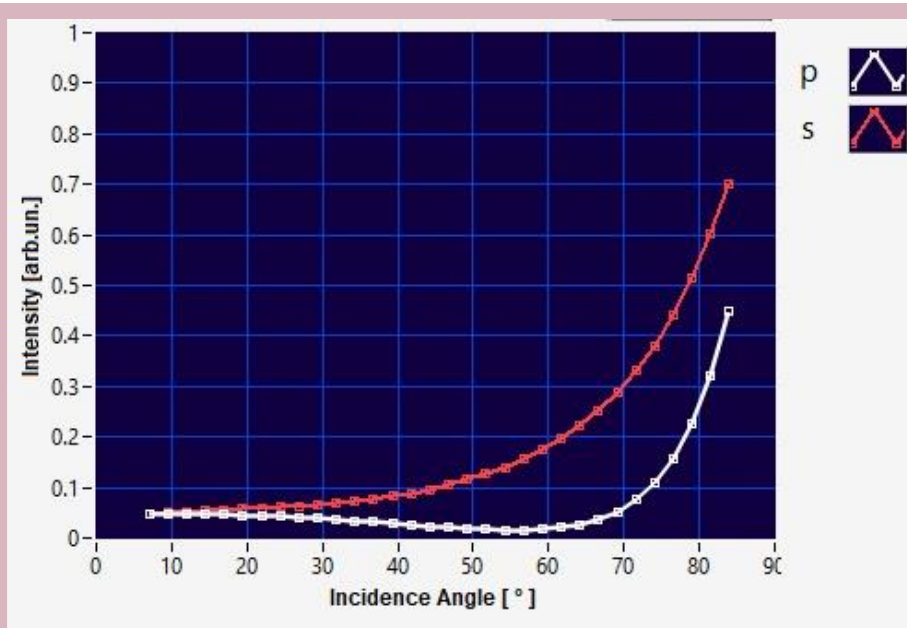
Mode of operation: Reflectance



- Illumination and detection arms at the same angle ($\theta_i = \theta_d$)
- Polarizers always aligned, either both p or both s
- The user can select the empty slot and 1 out of 8 different samples
- The user can perform a measurement as a function of $\theta_i = \theta_d$ choosing an interval in the range ($7^\circ, 83^\circ$) and with a number of steps
- The user can decide to measure with s, p or both polarizations
- The detector measures the power for every value of $\theta_i = \theta_d$



Mode of operation: Reflectance



The user can choose the empty slot and one out of 8 samples



MALUS LAW

PHASE RETARDATION

POINCARÉ SPHERE



TRANSMITTANCE

SCATTERING

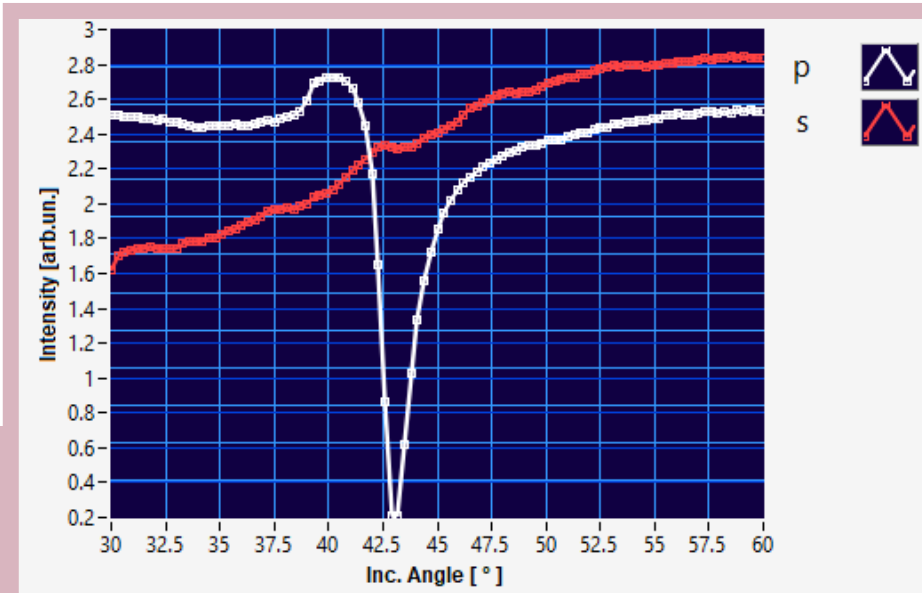
ELLIPSOMETRY

EXAMPLE 1

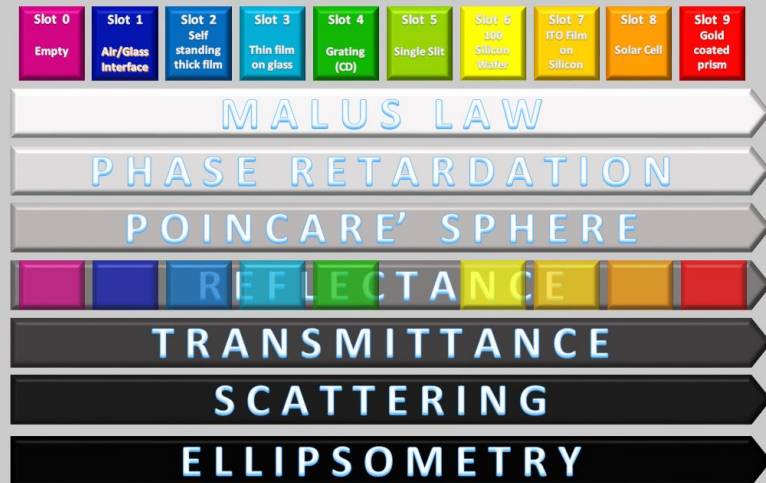
- Sample: Air/Glass Interface (Slot 1)
- $\theta_i = \theta_d \in (7^\circ, 83^\circ)$
- p and s polarization



Mode of operation: Reflectance



The user can choose the empty slot and one out of 8 samples

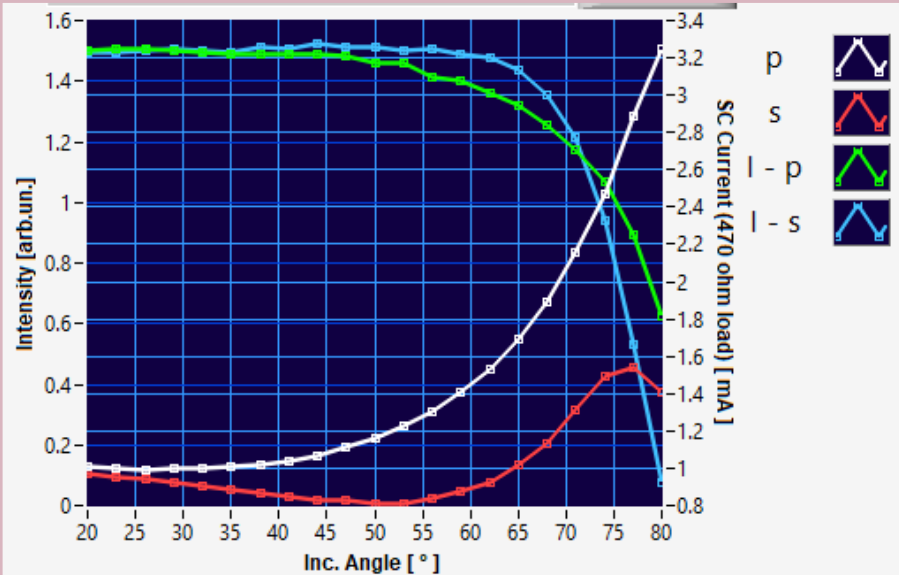


EXAMPLE 2

- Sample: Au Coated Prism (Slot 9)
- $\theta_i = \theta_d \in (30^\circ, 60^\circ)$
- p and s polarization



Mode of operation: Reflectance



EXAMPLE 3

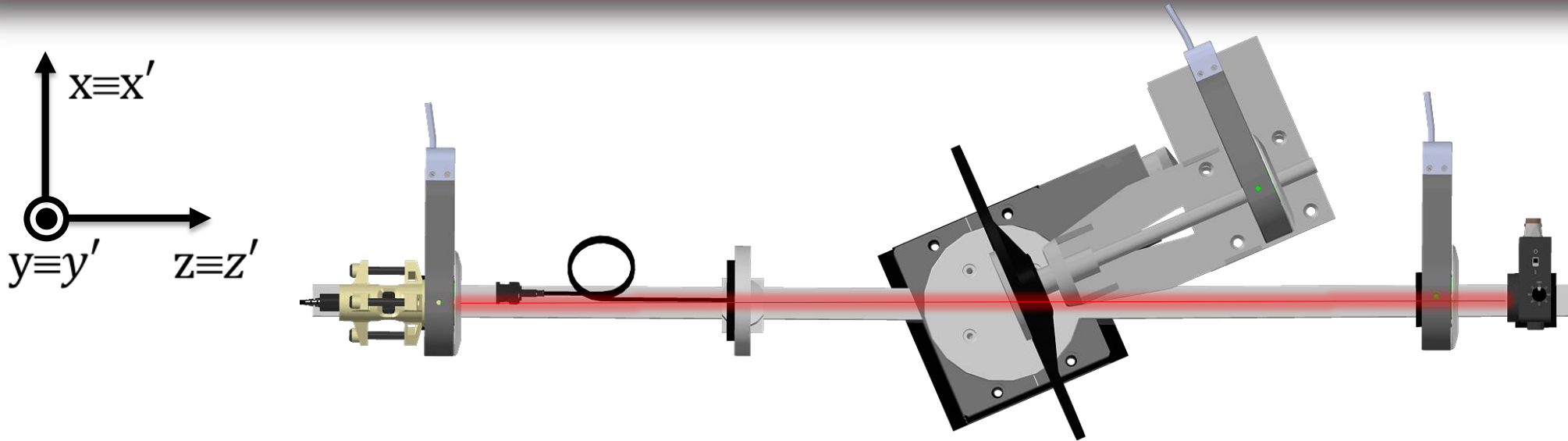
- Sample: Solar Cell (Slot 8)
- $\theta_i = \theta_d \in (30^\circ, 60^\circ)$
- p and s polarization
- Simultaneous measurement of reflectance and PV current

The user can choose the empty slot and one out of 8 samples





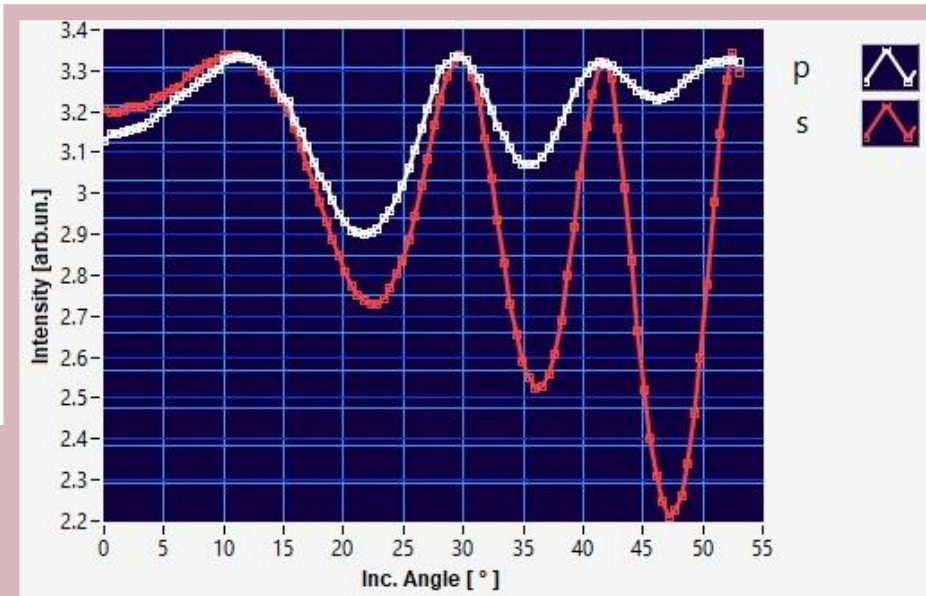
Mode of operation: Transmittance



- Illumination and detection aligned ($\theta_d = 180^\circ - \theta_i$)
- Polarizers always aligned, either both p or both s
- The user can select 1 out of 2 different samples
- The user can perform a measurement as a function of θ_i choosing an interval in the range $\theta_i \in (0^\circ, 60^\circ)$ and the number of steps
- The user can decide to measure with s, p or both polarizations
- The detector measures the power for every value of θ_i



Mode of operation: Transmittance



The user can choose one out of 2 samples

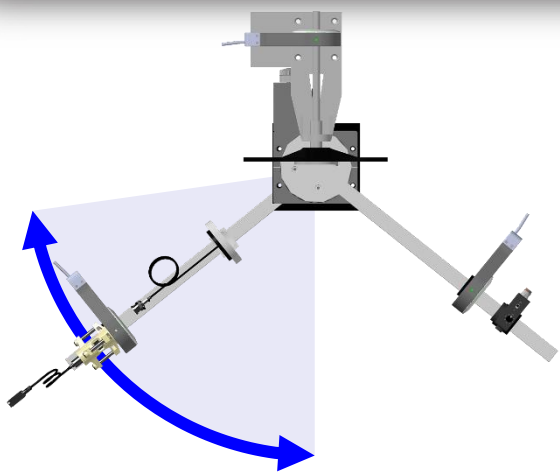


EXAMPLE

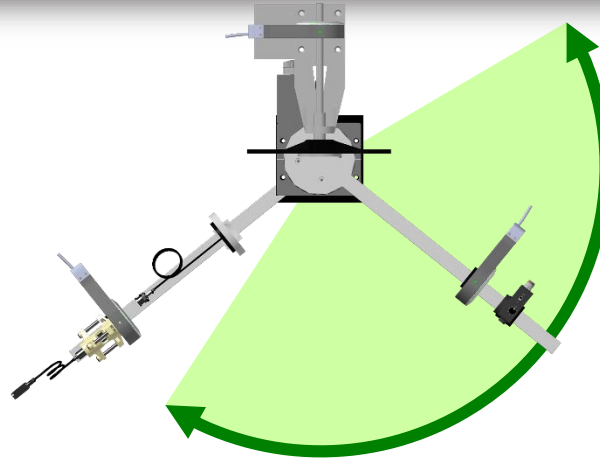
- Sample: Thin Film on Glass (Slot 2)
- $\theta_i \in (0^\circ, 55^\circ)$, $\theta_d = 180^\circ - \theta_i$
- 100 steps



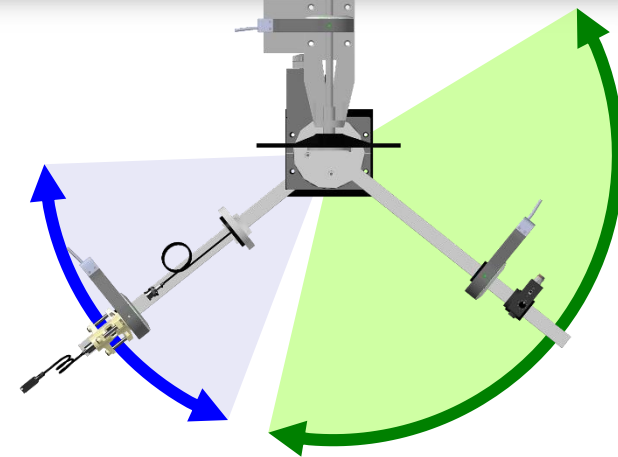
Mode of operation: Scattering



(1) Excitation scan



(2) Detection Scan

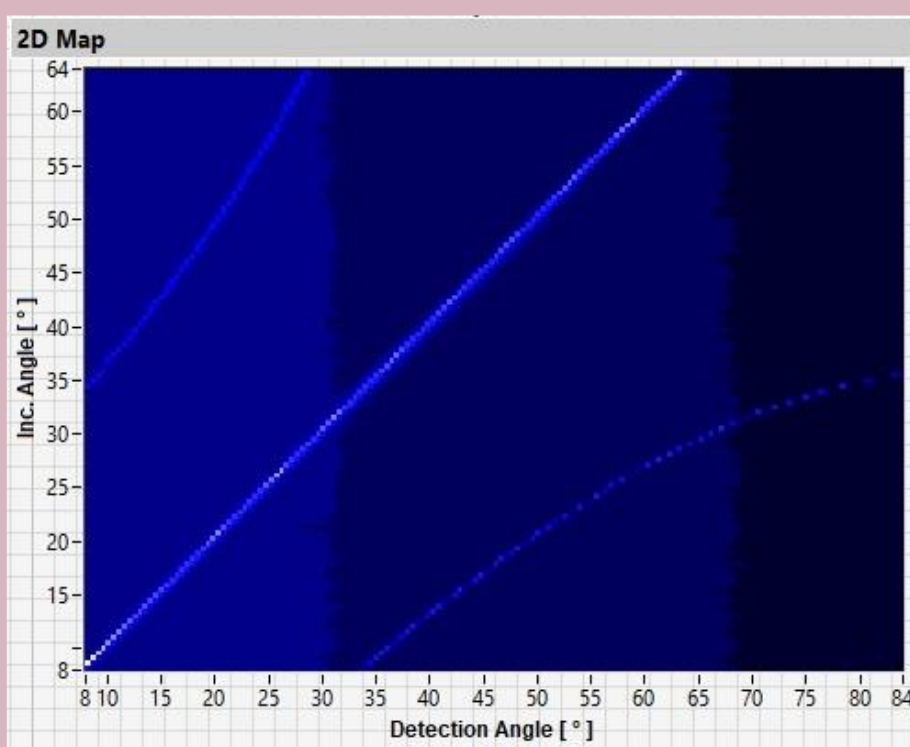


(3) Full Scan

- Three sub-modes of operation for the scattering measurement
- Polarizers always aligned along the p polarization
- The user can select 1 out of 9 different samples
- Mode (1): θ_i variable in $(0^\circ, 83^\circ)$ θ_d fixed in $(-\theta_{i,\min} + 15^\circ, 180^\circ)$
- Mode (2): θ_i fixed in $(0^\circ, 83^\circ)$ θ_d variable in $(-\theta_i + 15^\circ, 180^\circ)$
- Mode (3): θ_i variable in $(0^\circ, 83^\circ)$ θ_d variable in $(-\theta_{i,\min} + 15^\circ, 180^\circ)$
- The detector measures the power for every value of θ_i and θ_d



Mode of operation: Scattering



The user can choose one out of 9 samples

Slot 0 Empty	Slot 1 Alr/Glass Interface	Slot 2 Self standing thick film	Slot 3 Thin film on glass	Slot 4 Grating (CD)	Slot 5 Single Slit	Slot 6 100 Silicon Water	Slot 7 ITO Film on Silicon	Slot 8 Solar Cell	Slot 9 Gold coated prism
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MALUS LAW

PHASE RETARDATION

POINCARÉ SPHERE

REFLECTANCE

TRANSMITTANCE

SCATTERING

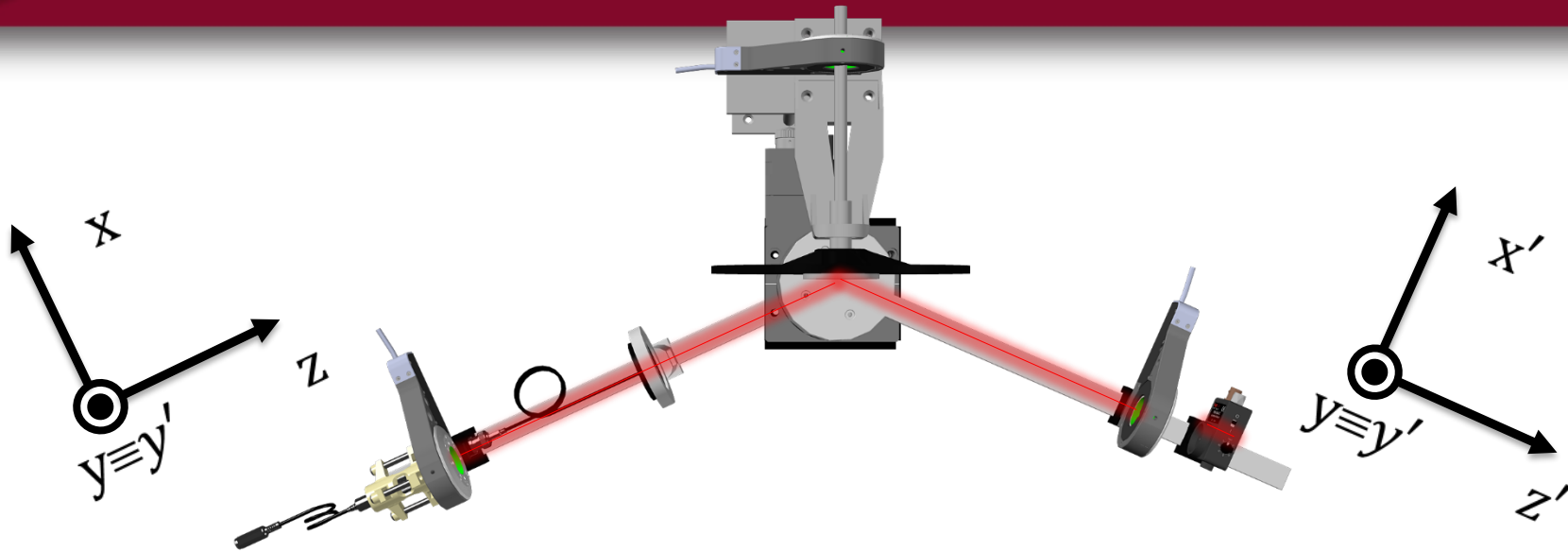
ELLIPSOMETRY

EXAMPLE

- Sample: Grating (CD) (Slot 4)
- $\theta_i \in (8^\circ, 64^\circ)$, $\theta_d \in (8^\circ, 83^\circ)$
- Full Scattering, p polarization



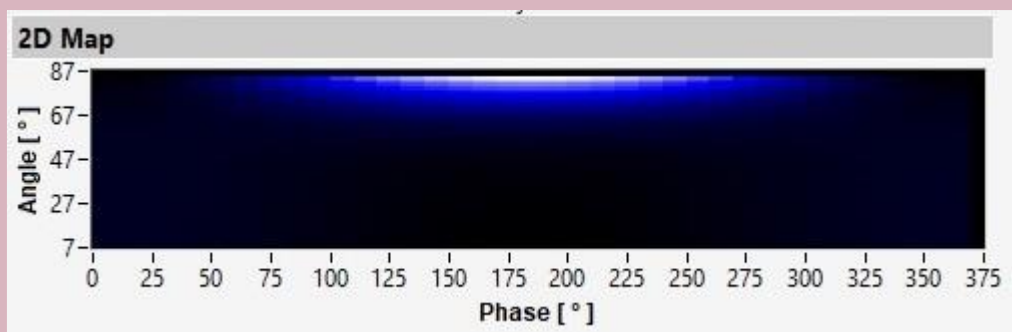
Mode of operation: Ellipsometry



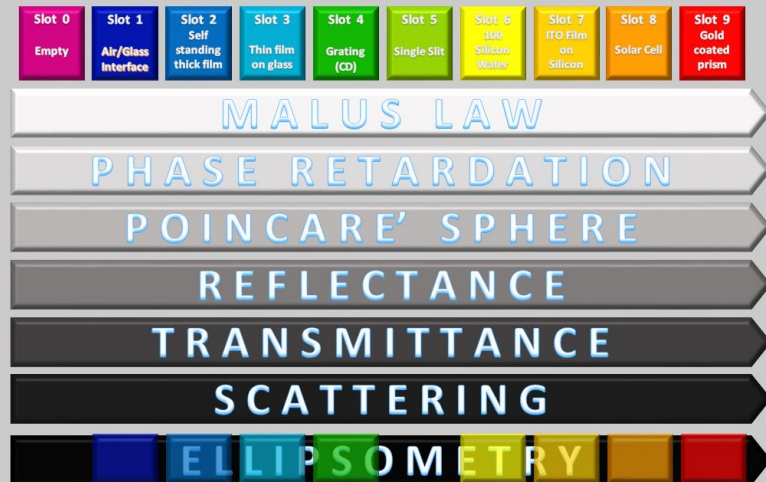
- Illumination and detection arms at the same angle ($\theta_i = \theta_d$)
- Polarizers always crossed, with $\varphi_{pol} = 45^\circ$ and $\varphi_{an} = -45^\circ$
- The user can select 9 different samples
- The user can perform a measurement as a function of $\theta_i = \theta_d$ in the range ($7^\circ, 83^\circ$) and as a function of Ψ in the range ($0^\circ, 360^\circ$)
- For each independent variable one can choose the number of steps
- The detector measures the power for every value of $\theta_i = \theta_d$ and Ψ



Mode of operation: Ellipsometry



The user can choose one out of 9 samples

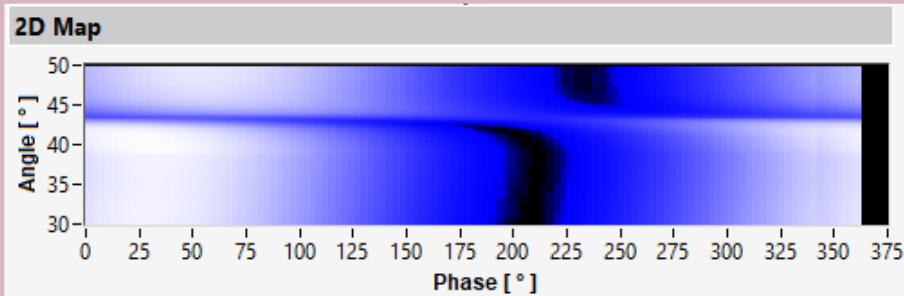


EXAMPLE 1

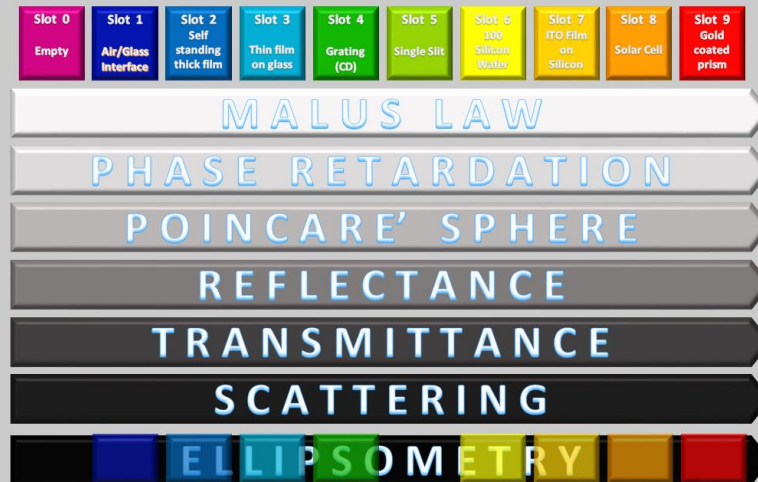
- Sample: Glass/Air Interface (Slot 1)
- $\Psi \in (0^\circ, 360^\circ)$
- $\theta_i = \theta_d \in (7^\circ, 83^\circ)$



Mode of operation: Ellipsometry



The user can choose one out of 8 samples



EXAMPLE 2

- Sample: Au Coated Prism (Slot 9)
- $\Psi \in (0^\circ, 360^\circ)$
- $\theta_i = \theta_d \in (30^\circ, 50^\circ)$



Summary

