R2R Optical Inspection on the ECD

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Overview For Inpsection

- ECD will be equipped with four different sensors for real-time analysis over the entire moving substrate

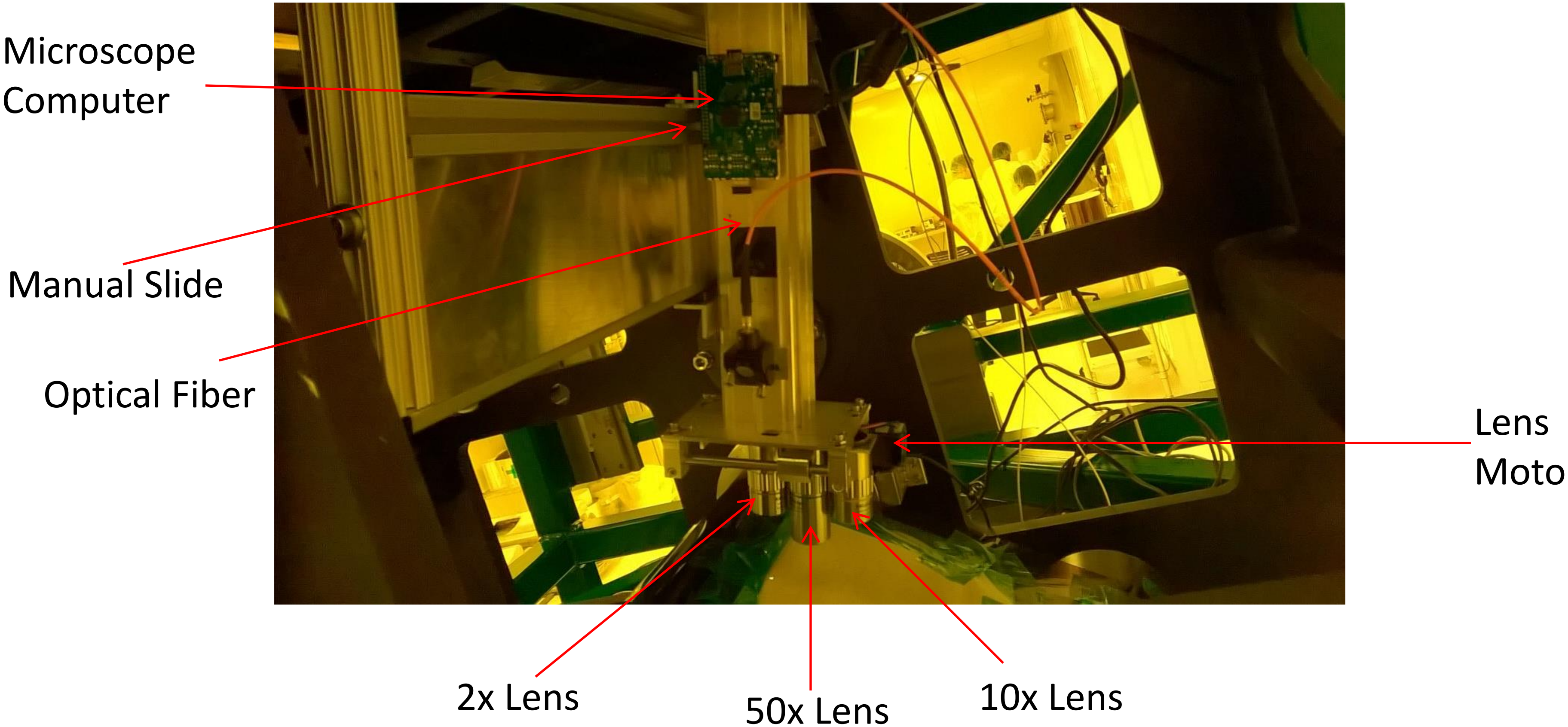
1)Bright Field Microscope (2x,10x,50x)

2)Spectroscopic Reflectometer

3)Surface Roughness Sensor

4)Three Networked Defect Inspection

Bright Field Microscopy



For the Inspection of Flexible Glass and Plastics:

Good for the Inspection and Imaging of:

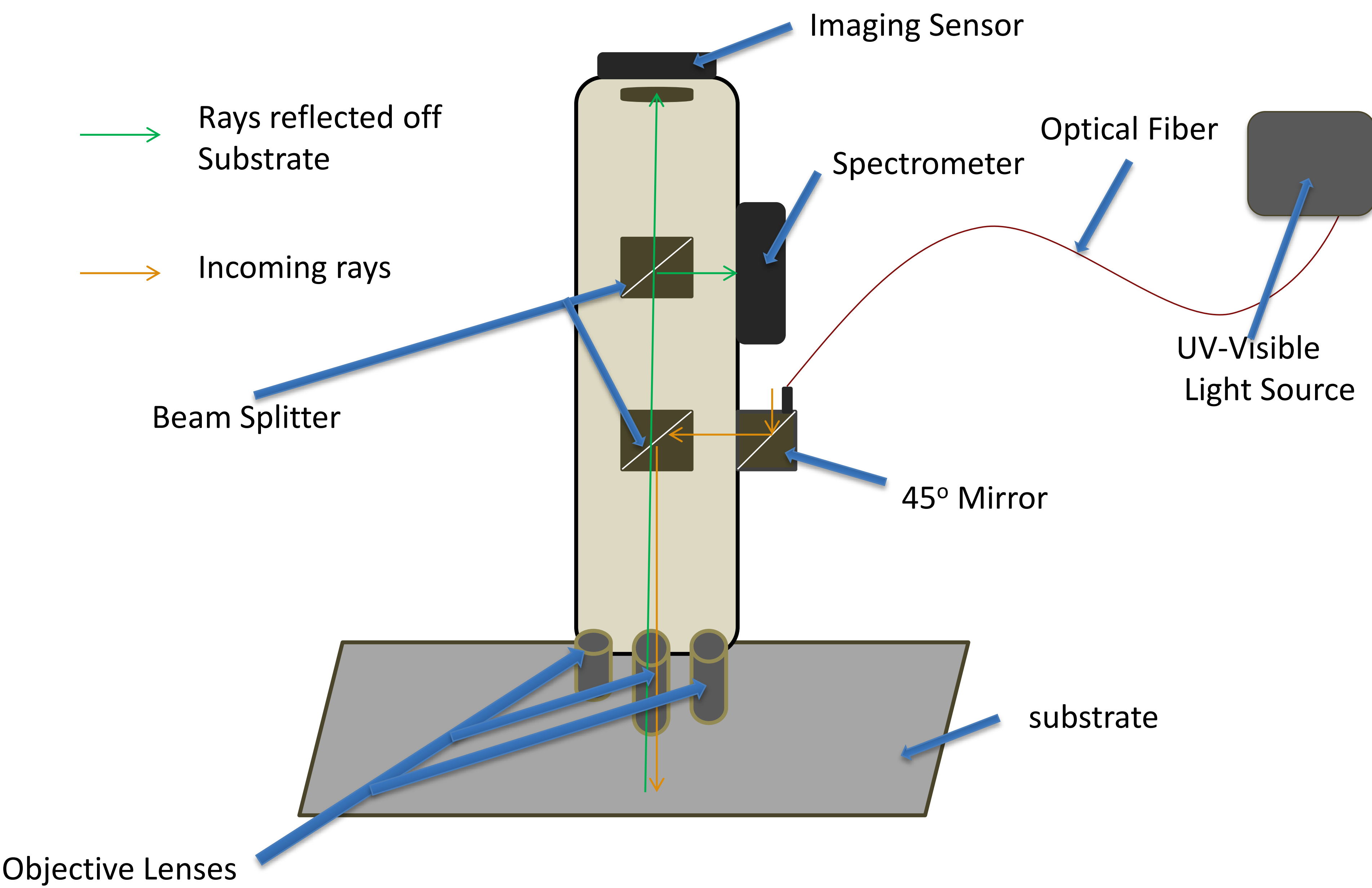
-Non-Uniformities
-Stains
-Smudges
-Corrosion

Objective Lens and Microscope Specs

	2x	10x	50x
Field Of View	9.6mm x 5.4mm	1.97mm x 1.08mm	0.38mm x 0.22mm
Imaging Resolution	5µm	2µm	.5µm
Working Distance	34mm	33.5mm	13mm
Imaging Sensor Resolution	1920 x 1080, 30 fps		

- Large working distance, even at high magnification = more convenient
- Impressive imaging resolution range (.5µm – 5µm)

Simplified Schematic



BWTEK Exemplar Spectrometer

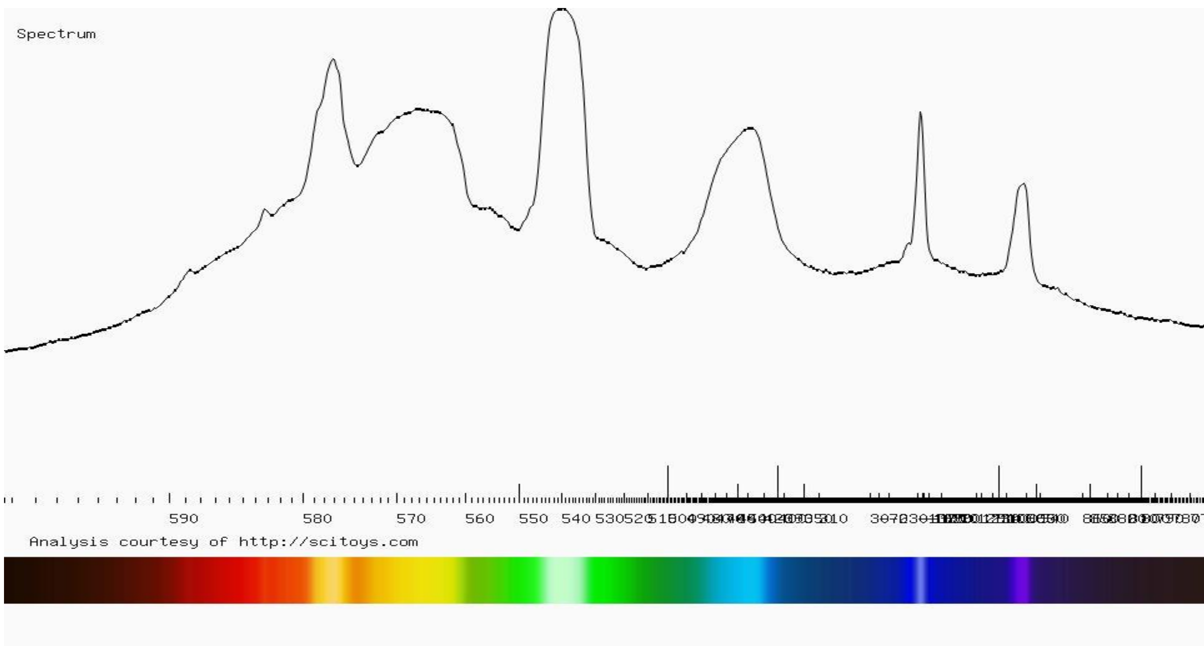
- 2nm Resolution
- 1000 spectrums/sec
- 50µm slit width

Benefits

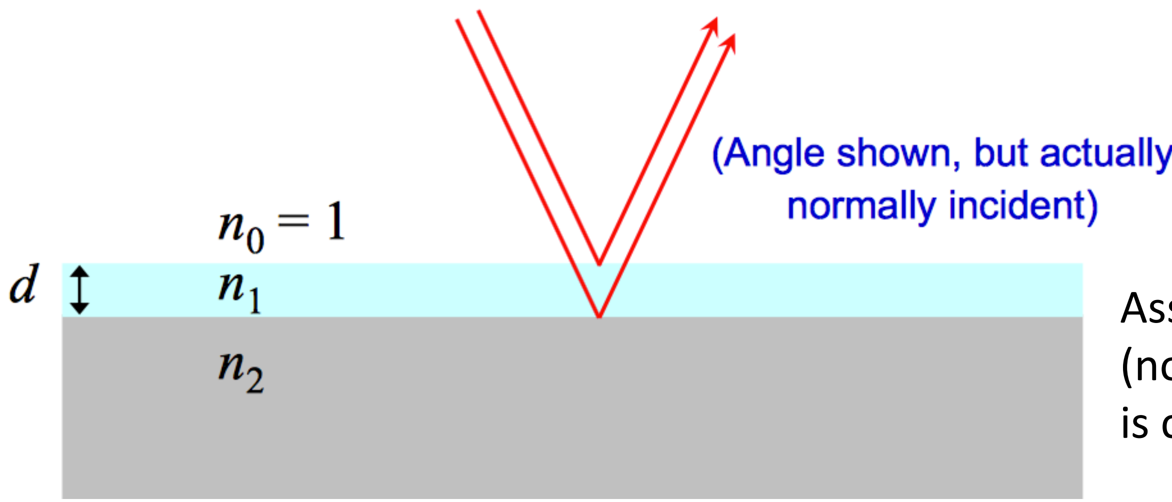
Provides means to analyze the different reflectance intensities based on varying wavelengths of a roll to roll substrate. Can be calibrated to measure thickness of multiple layered thin films.

Spectral Analysis of 350nm to 800nm

Once installed, will be able to analyze the wavelength intensities from UV, visible, and near-infrared light reflected from the substrate



Thin Film Interference Analysis



Assume $n_1 < n_0$ and $n_2 < n_1$ (no additional phase change is considered)

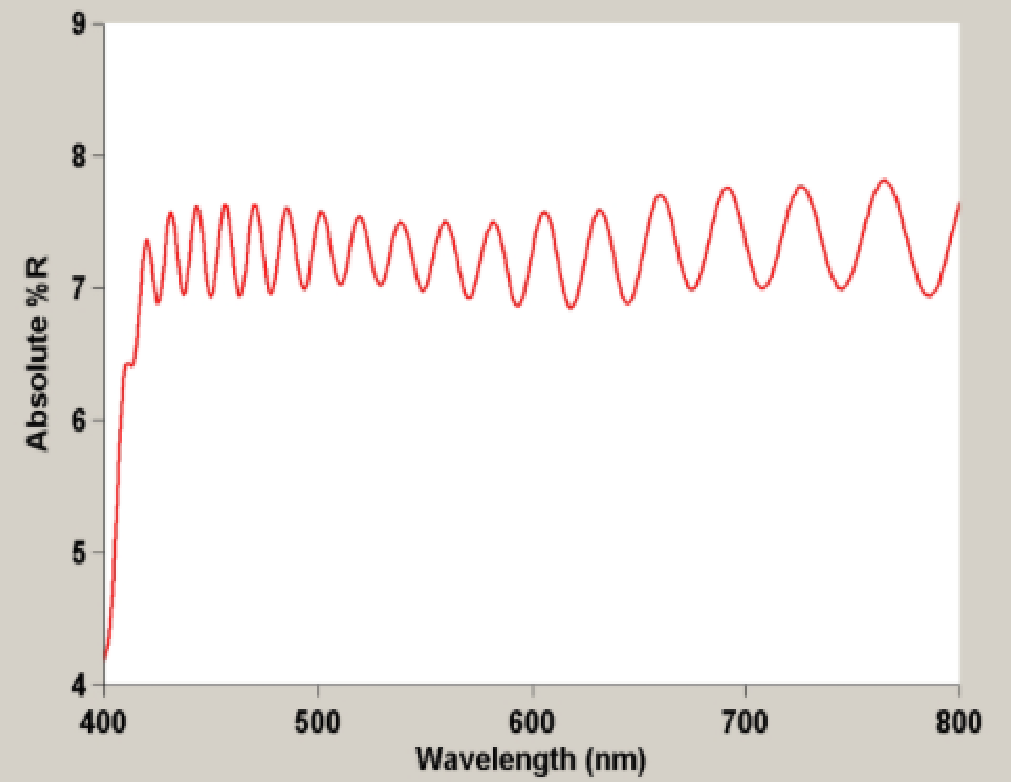
$\lambda_{n1} = \lambda / n_1$

$$2d = m\lambda_{n_1} \quad \text{Max (constructive)}$$

$$2d = \left(m + \tfrac{1}{2}\right)\lambda_{n_1} \quad \text{Min (destructive)}$$

Spectrometer Film Thickness Example

$$d = \frac{m}{2D_n\sqrt{(n^2 - \sin^2\theta)}}$$



Where:

d = film thickness

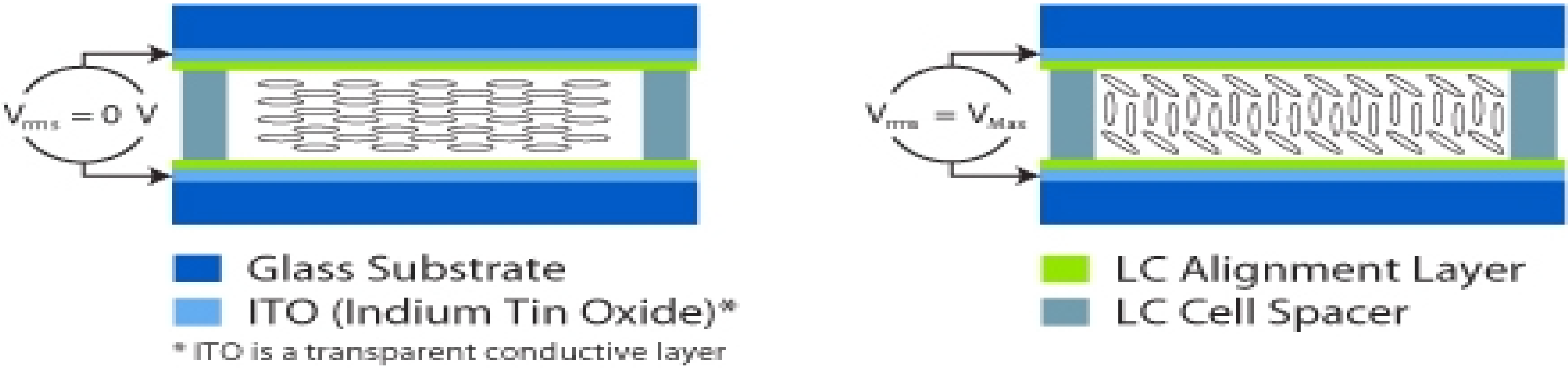
m = number of fringes in wavenumber region used

n = refractive index

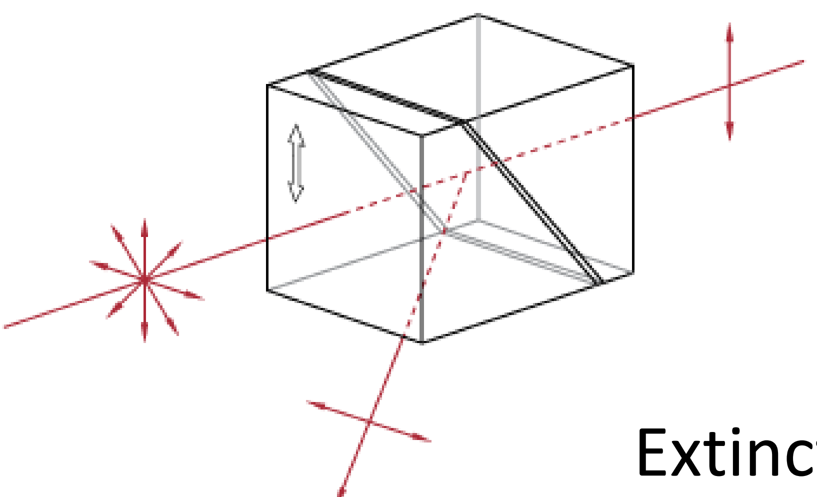
θ = angle of incidence

D_n = wavenumber region used (v1 - v2; cm^{-1})

Liquid Crystal Retarder



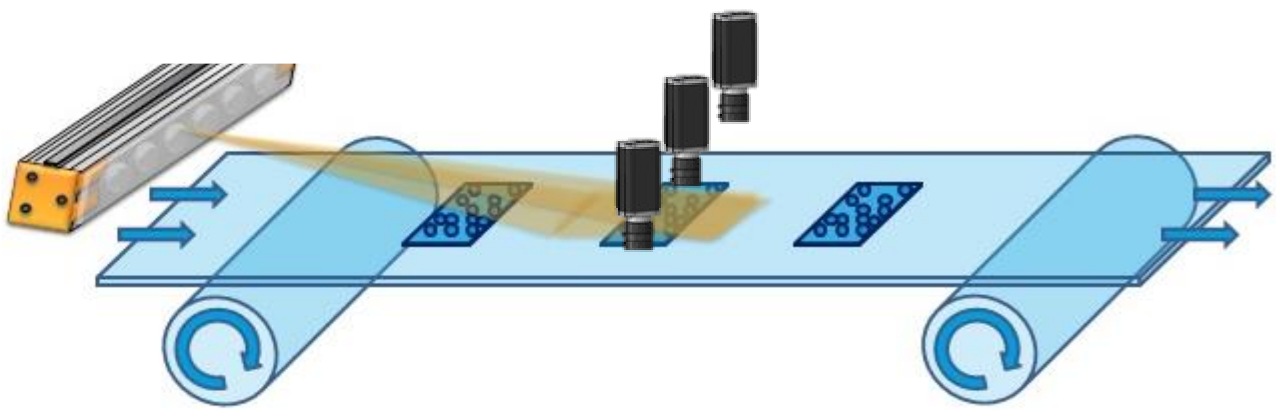
Glan-Taylor Polarizer



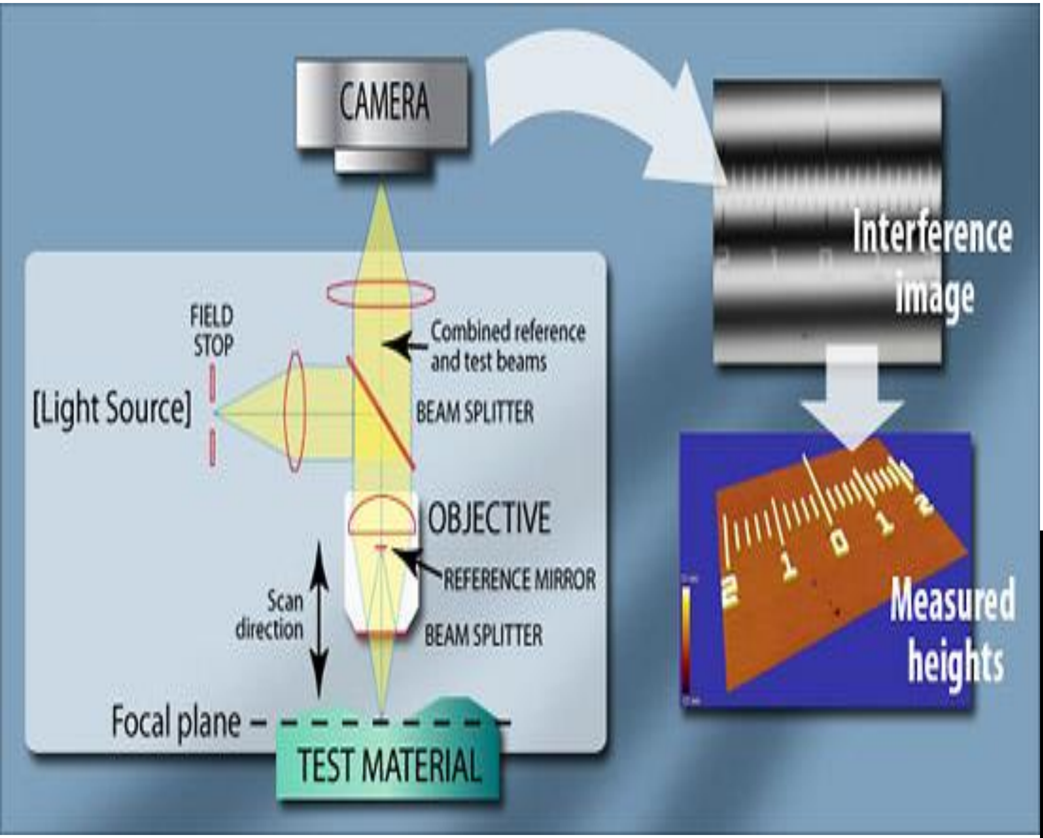
Extinction Ratio:100,000:1

What's To Come

- Surface Roughness Sensor For Thin Film Metal Deposition and Edge/Splice Inspection
- Multiple Networked Inspection Sensors For Full Roll Surface Defect Inspection Using Dark Field Lighting



Optical Interferometer Surface Roughness



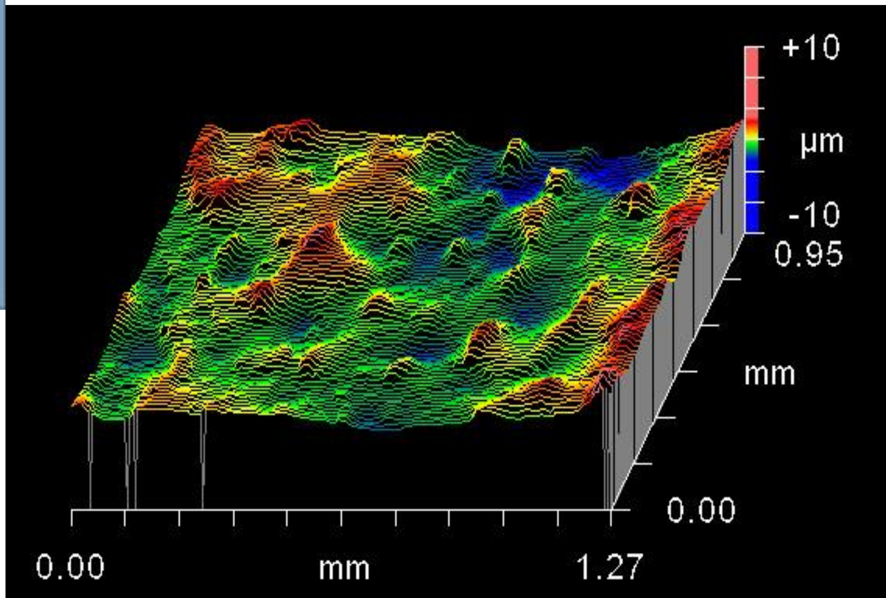
Benefits:

-Non Contact

-Extremely Accurate Measurements (≈1nm)

-Quick Mapping (≈12 µsec Exposure Time)

-No Styli Destruction

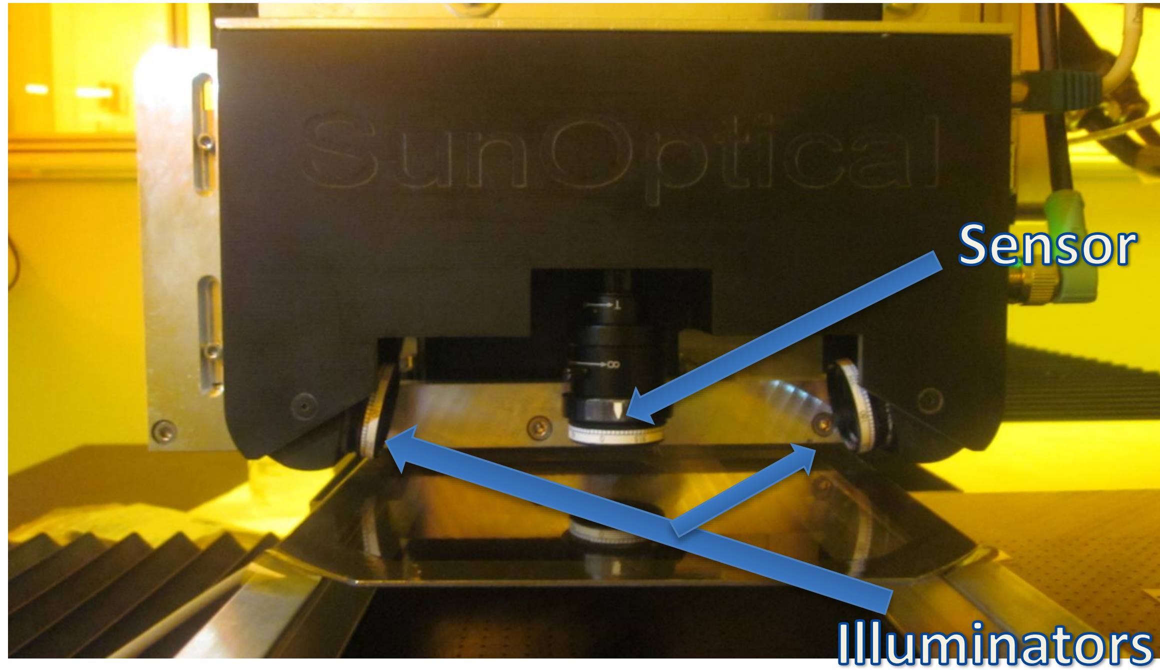


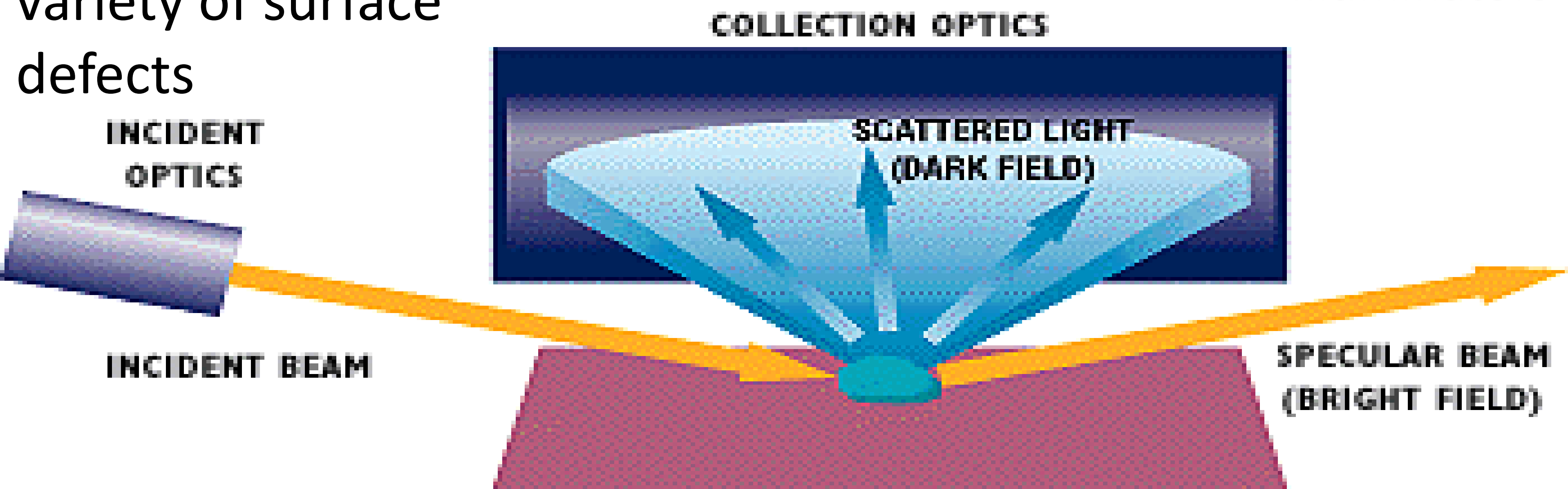
Calculates phase shift difference between a known distance and the distance to a point on the substrate using wavelength interference

Defect Sensor

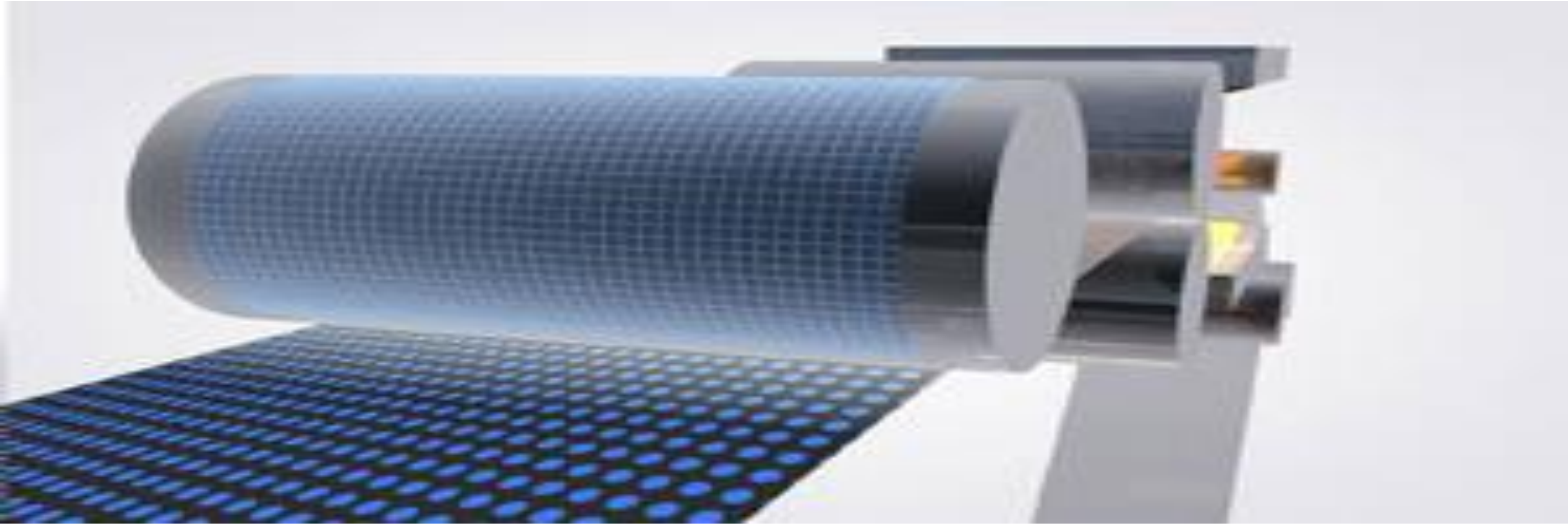
- 3 networked sensors, allow for a full roll coverage

- Different software algorithms allow for identification of a variety of surface defects





Pattern Recognition Ability



- Ability to recognized patterned rolls to analyze any defects on individual components

- Automatic edge inspection, even low contrast

Obstacles to Overcome

- Customized Design For Installation on ECD

- Alleviating any external disturbances (vibration)

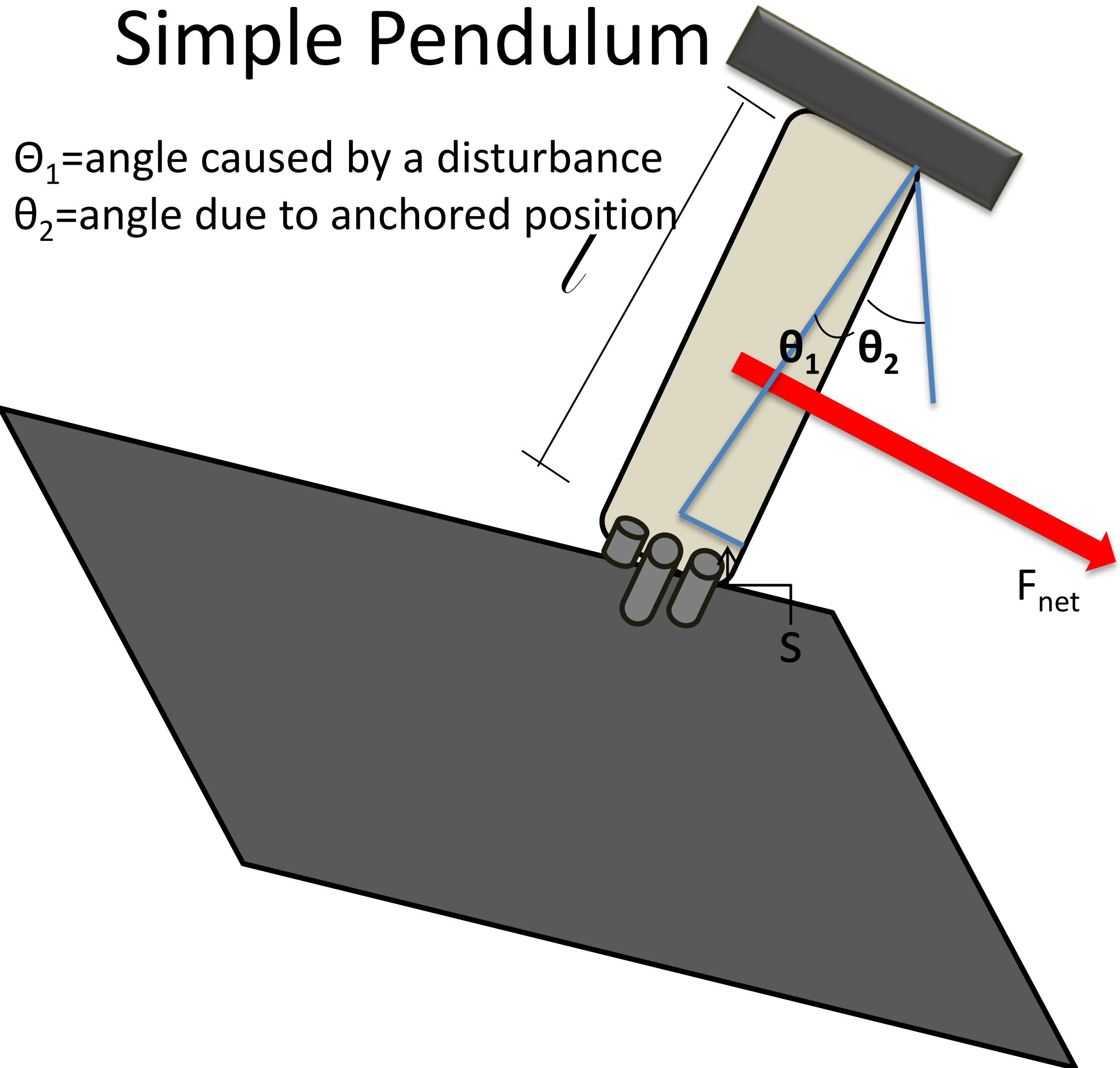
- Real-Time ability to scan entire surface of a moving roll

Alleviating Vibration

Simple Pendulum

Θ_1=angle caused by a disturbance

θ_2=angle due to anchored position



2 Important Equations:

- $l(\sin\theta_1) = s$

  $\sin\theta_1=\theta_1$

  $l\theta_1= s$

- $F_{net}=ma$

  $F_{net}=mg(\sin\theta_2)$

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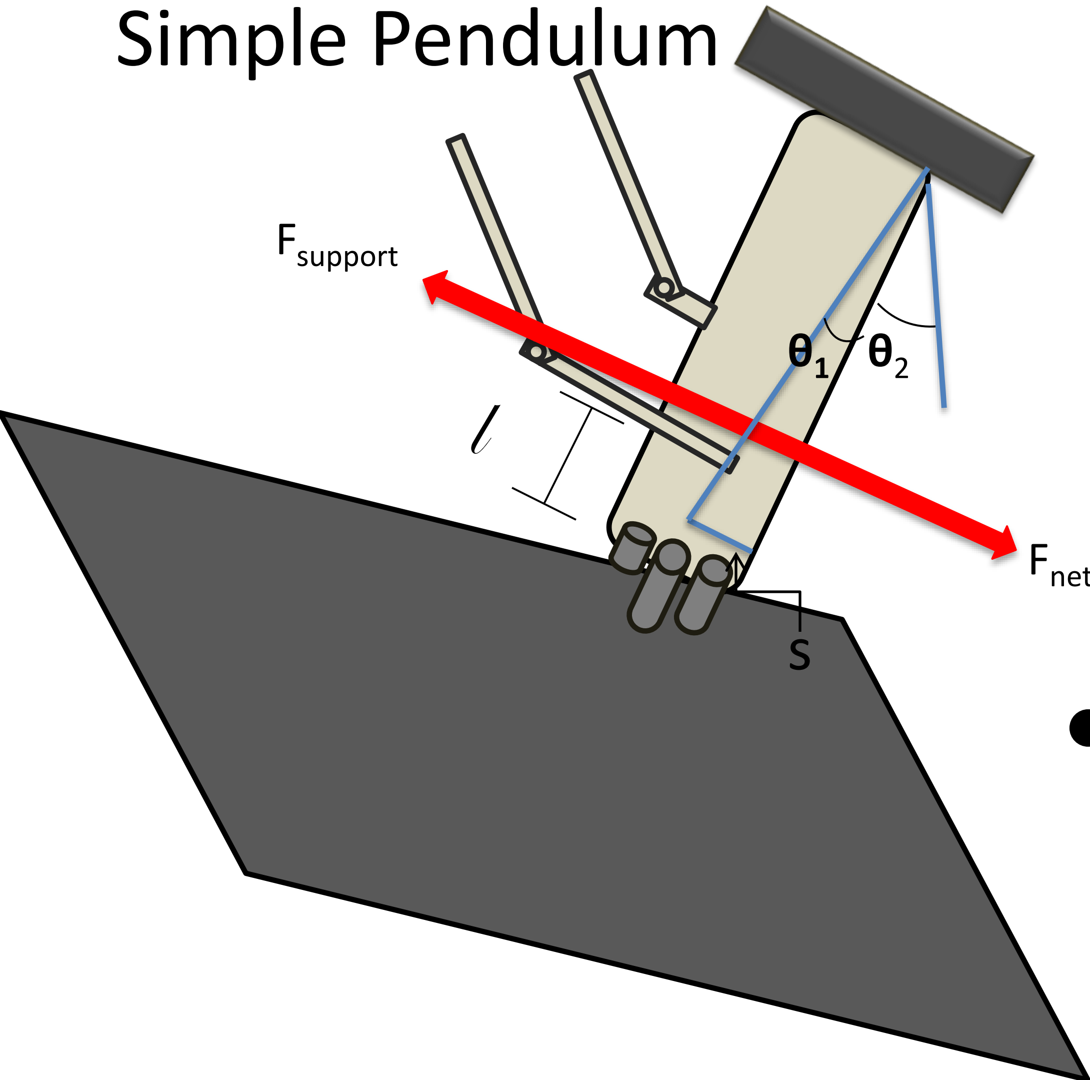
Simple Pendulum



- $l(\theta_1) = s$

Keeping theta constant:

A decrease in l, will result in a decrease in s.

- $F_{support} = F_{net} = mg\sin(\theta_2)$

10x Lens, Vibration Comparison

Without Support System (Web is moving)

With Support System (Web is moving)

2x Lens, Vibration Comparison

Without Support System (Web is not moving)

With Support System (Web is not moving)