EPFL

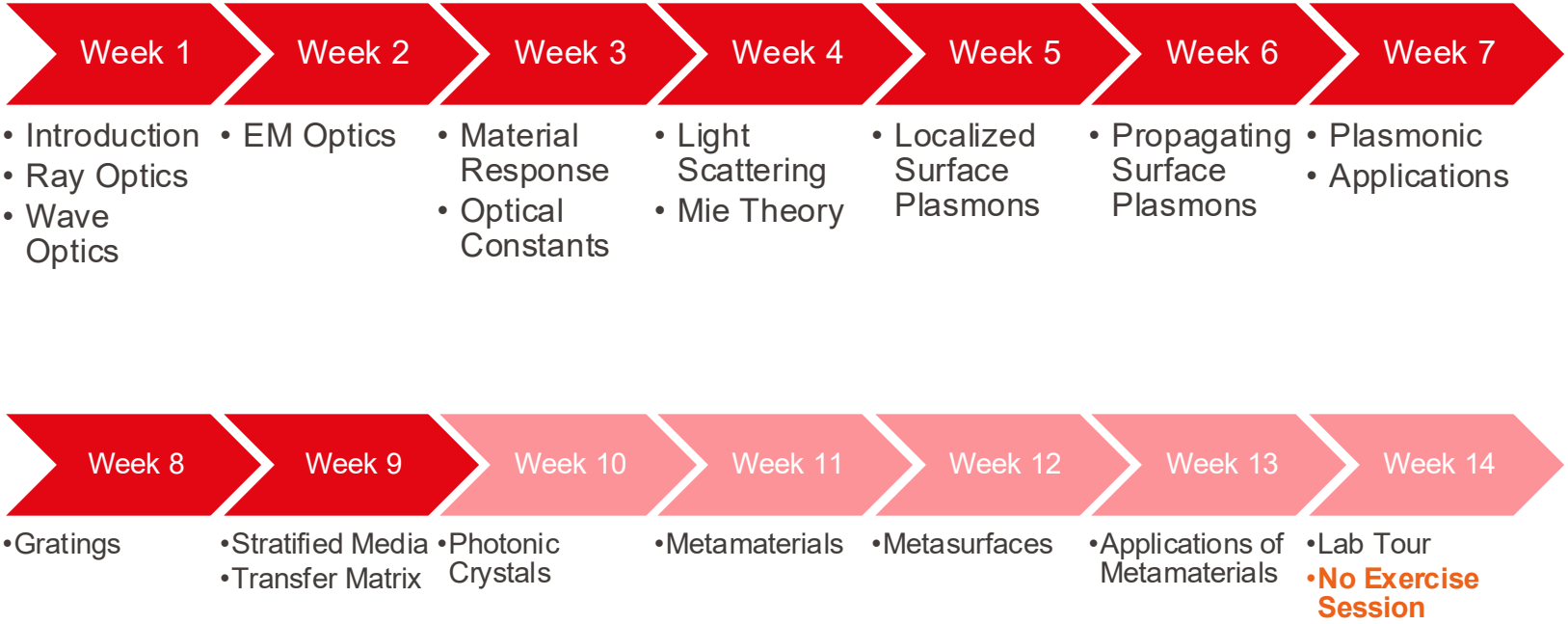
Week 9

(Stratified Media)

Stavros Athanasiou

Lausanne, 11 Nov 2025

Course Timeline



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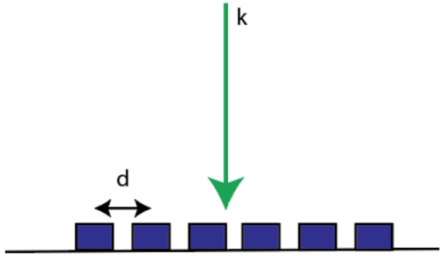
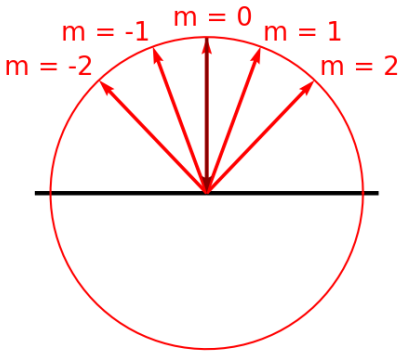
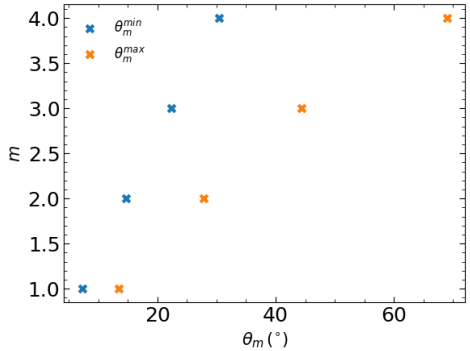
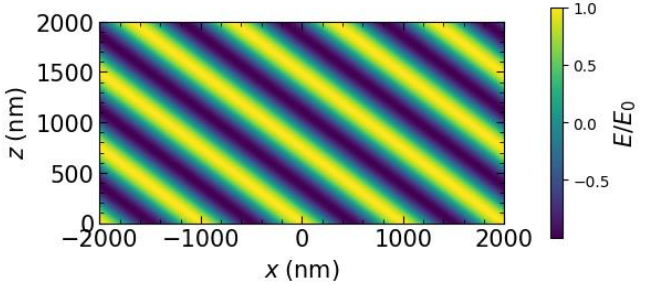
Last Week: Gratings

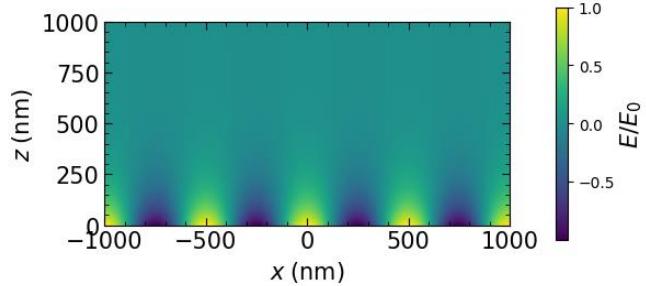
1. Visualizing the Diffraction Orders
2. Overlap of Diffraction Orders
3. Propagating and Evanescent Modes











This Week: Stratified Media / 1

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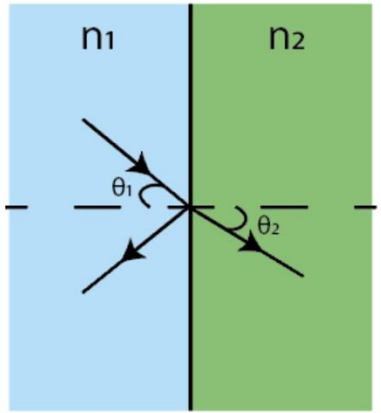
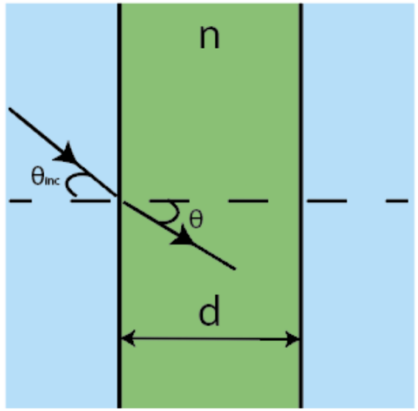
- Derivation and Implementation of the Transfer Matrix
  1. Reflection/Transmission from an interface
  2. Propagation through a medium





$$M_{12}^k = \frac{1}{2a_{21}^k \tilde{n}_2^k} \begin{pmatrix} \tilde{n}_2^k + \tilde{n}_1^k & \tilde{n}_2^k - \tilde{n}_1^k \\ \tilde{n}_2^k - \tilde{n}_1^k & \tilde{n}_2^k + \tilde{n}_1^k \end{pmatrix} \qquad M_P = \begin{pmatrix} e^{i\phi} & 0 \\ 0 & e^{-i\phi} \end{pmatrix}, \quad \phi = 2\pi n \frac{d\cos\theta}{\lambda}$$

Transfer Matrix Approach

We typically follow the steps below

1. Use Fresnel coefficients to compute all S matrices.
2. Convert S matrices to M matrices.
3. Concatenate M matrices.
4. Convert the resulting M matrix into S to obtain total reflectance and transmittance.

This Week: Stratified Media / 2

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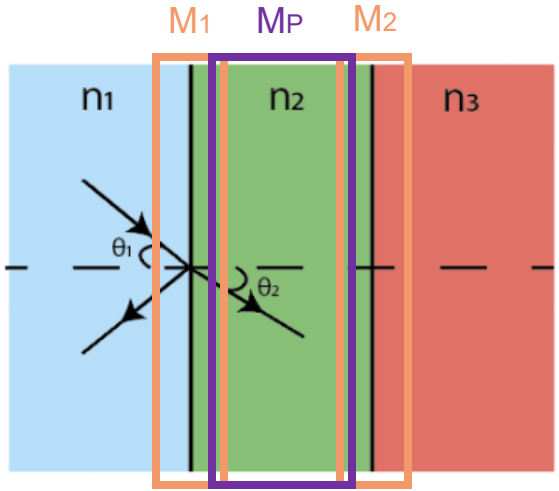
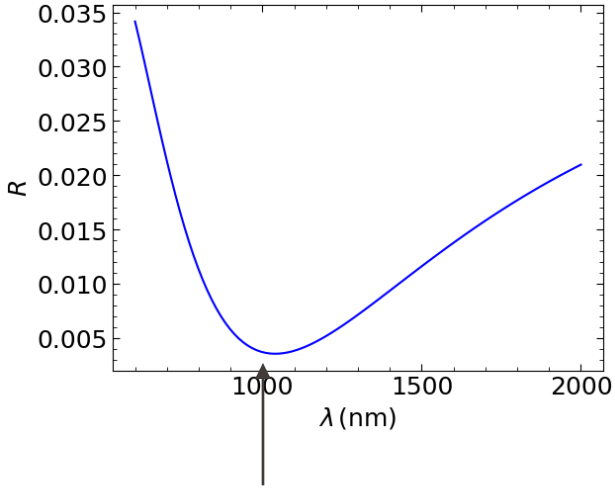
We provide three examples of applying the transfer matrix approach.

a) Two-Interface Layered Structure



$$M_{tot} = M_2 M_p M_1 \rightarrow S$$



Question: When does R go to zero?

This Week: Stratified Media / 2

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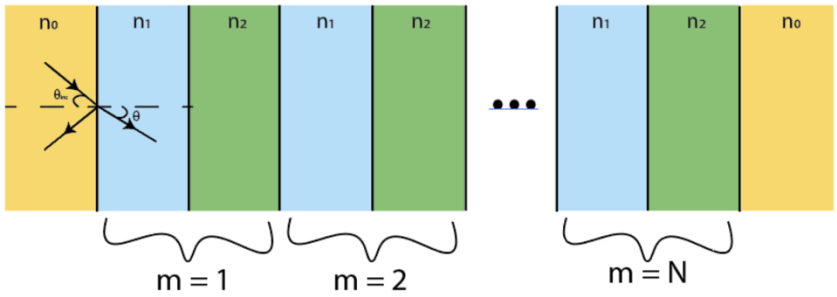
We provide three examples of applying the transfer matrix approach.

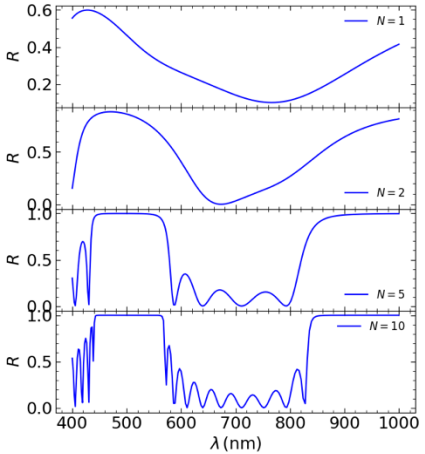
a) Two-Interface Layered Structure

b) Dielectric Bragg Reflector



$$M_{tot} = M_{N+1,N} \cdot M_{p_2}^N \cdot M_{N,N} \cdot M_{p_1}^N \cdots M_{p_2}^1 \cdot M_{1,1} \cdot M_{p_1}^1 \cdot M_{0,1}$$

$$\rightarrow S$$



This Week: Stratified Media / 2

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We provide three examples of applying the transfer matrix approach.

a) Two-Interface Layered Structure

b) Dielectric Bragg Reflector

c) Fabry-Perot Etalon-Mirror

DBR with N = 1,
n1 = n2 and
layer width = d/2.