

Optoelectronică

Curs 2

2025/2026

Disciplina 2025/2026

- ▶ 2C/1L Optoelectronică **OPTO**
- ▶ **Minim 7 prezente curs + laborator**
- ▶ Curs – conf. **Radu Damian**
 - an IV μ E
 - Marti 14:00–16:00, P8
 - E – 70% din nota (50%+20%)
 - **20% test (VP) la curs**, saptamana 4–6?
 - probleme + (2p prez. curs)
 - toate materialele permise
- ▶ Laborator – sl. **Catalin Iov**
 - an IV μ E
 - Marti 16–18
 - Max. 7 prezente
 - L – 30% din nota (+Caiet de laborator +Probleme)

Cuprins

- ▶ **Lumina ca undă electromagnetică*** (ecuațiile lui Maxwell, ecuația undelor, parametri de propagare)
- ▶ **Elemente de fotometrie și radiometrie*** (mărimi energetice/luminoase)
- ▶ **Fibra optică** (realizare, principiu de funcționare, atenuare, dispersie, banda de frecvență)
- ▶ **Cabluri optice** (tehnologie, conectori, lipire – splice)
- ▶ **Proiectare sistemică a legăturii pe fibra optică** (bandă de frecvență, balanța puterilor)
- ▶ **Emitătoare optice** (LED și dioda laser – realizare fizică și funcționare)
- ▶ **Receptoare optice** (dioda PIN, dioda cu avalanșă – realizare fizică și funcționare)
- ▶ **Amplificatoare transimpedanță** (parametri, scheme tipice, TIA în buclă deschisă, cu reacție, diferențiale, control automat al câștigului)
- ▶ **Realizarea circuitelor pentru controlul emițătoarelor optice** (parametri, scheme tipice, controlul puterii, multiplexoare)
- ▶ **Dispozitive de captare a energiei solare** (principiu de funcționare, utilizare, proiectare)

* – VP

Bibliografie

- ▶ <https://rf-opto.etti.tuiasi.ro>
- ▶ Irinel Casian-Botez, "Structuri Optoelectronice", Ed. "CANOVA", Iasi 2001, ISBN 973-96099-2-9
- ▶ Behzad Razavi – Design of Integrated Circuits for Optical Communications, Mc Graw Hill
- ▶ John Powers – An Introduction to Fiber Optic Systems
- ▶ IBM – Understanding Optical Communications: on-line <http://www.redbooks.ibm.com>
- ▶ Radu Damian, I Casian, D Matăsară – „Comunicatii Optice” , Indrumar de laborator * , 2005
- ▶ MIT Course – Fundamentals of Photovoltaics, <https://ocw.mit.edu>

Documentatie

[Main](#) [Courses](#) [Master](#) [Staff](#) [Research](#) [Students](#)

[Microwave CD](#) [Optical Communications](#) [Optoelectronics](#) [Internet](#) [Antennas](#) [Technology/Noise](#) [Practica](#)

Optoelectronics

Course: OPTO (2023-2024)

Course Coordinator: Assoc.P. Dr. Radu-Florin Damian
Code: DID405M
Discipline Type: DID; Required, Domain
Credits: 4
Enrollment Year: 4, Sem. 8

Activities

Course: Instructor: Assoc.P. Dr. Radu-Florin Damian, 2 Hours/Week, Specialization Section, Timetable:
Laboratory: Instructor: Assist.P. Dr. Petre-Daniel Matasaru, 1 Hours/Week, Group, Timetable:

Evaluation

Type: **Colloquium**

A: 50%, (Test/Colloquium)
B: 30%, (Seminary/Laboratory/Project Activity)
C: 20%, (Tests during semester)

Previous years

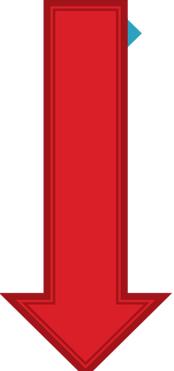
2022-2023	2021-2022	2020-2021	2019-2020	2018-2019	More years...
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Server-ul "rf-opto" pastreaza istoricul materialelor pentru anii anteriori
Alegeti anul recent corespunzator pentru vizualizare sau "More years" pentru a afisa mai multi ani din istoric

Documentatie

- ▶ RF-OPTO
 - <https://rf-opto.etti.tuiasi.ro>
- ▶ Fotografie
 - “examen” online
 - necesara la laborator/curs

Istoric



Main **Courses** Master Staff Research Students

Microwave CD Optical Communications **Optoelectronics** Internet Antennas Technology/Noise Practica

Optoelectronics

Course: OPTO (2023-2024)

Course Coordinator: Assoc.P. Dr. Radu-Florin Damian
Code: DID405M
Discipline Type: DID; Required, Domain
Credits: 4
Enrollment Year: 4, Sem. 8

Activities

Course: Instructor: Assoc.P. Dr. Radu-Florin Damian, 2 Hours/Week, Specialization Section, Timetable:
Laboratory: Instructor: Assist.P. Dr. Petre-Daniel Matasaru, 1 Hours/Week, Group, Timetable:

Evaluation

Type: **Colloquium**

A: 50%, (Test/Colloquium)
B: 30%, (Seminary/Laboratory/Project Activity)
C: 20%, (Tests during semester)

Previous years

2022-2023	2021-2022	2020-2021	2019-2020	2018-2019	More years...
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Server-ul "rf-opto" pastreaza istoricul materialelor pentru ani anteriori.
Alegeti anul recent corespunzator pentru vizualizare sau "More years" pentru a afisa mai multi ani din istoric.

Istoric 2004–2025

Previous years

2018-2019

2017-2018

2016-2017

2015-2016

2014-2015

More years...

Optoelectronics

Course: OPTO (2018-2019)

Course Coordinator: Assoc.P. Dr. Radu-Florin Damian

Code: DIS405M

Discipline Type: DID; Required, Domain

Credits: 3

Enrollment Year: 4, Sem. 8

Activities

Course: Instructor: Assoc.P. Dr. Radu-Florin Damian, 2 Hours/Week, Specialization Section

Laboratory: Instructor: Assist.P. Dr. Petre-Daniel Matasaru, 1 Hours/Week, Group, Timetable:

Evaluation

Type: **Colloquium**

A: 50%, (Test/Colloquium)

B: 30%, (Seminary/Laboratory/Project Activity)

C: 20%, (Tests during semester)

Grades

[Aggregate Results](#)

Attendance

Previous years

2018-2019

2017-2018

2016-2017

2015-2016

2014-2015

2013-2014

2012-2011

Optoelectronics, Structures, Technologies, Circuits

Course: OSTC (2013-2014)

Course Coordinator: Assoc.P. Dr. Radu-Florin Damian

Code: DIS405M

Discipline Type: DIS; Required, Specialty

Credits: 4

Enrollment Year: 4, Sem. 7

Activities

Course: Instructor: Assoc.P. Dr. Radu-Florin Damian, 2 Hours/Week, Specialization Section, Timetable:

Laboratory: Instructor: Assist.P. Dr. Petre-Daniel Matasaru, 1 Hours/Week, Half Group, Timetable:

Evaluation

Type: **Colloquium**

A: 66%, (Test/Colloquium)

B: 17%, (Seminary/Laboratory/Project Activity)

D: 17%, (Homework/Specialty papers)

Grades

[Aggregate Results](#)

Materials

Fotografii

Start Didactic Master Colectiv Cercetare **Studenti** Admin

Note Lista Studenti Fotografii Statistici

Grupa 5403

Nr. Student	Prezent	Nr. Student	Prezent	Nr. Student	Prezent
1 ANGHIELUS IONUT-MARIUS	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	2 ANTIGHIN FLORIN-RAZVAN	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	3 ANTONICA BIANCA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:
4 APOSTOL PAVEL-MANUEL	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	5 BALASCA IULIAN-PETRU	<input checked="" type="checkbox"/> Puncte: 0 Nota: 0 Obs:	6 BOSTAN ANDREI-PETRIKA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:
7 BOTEZAT EMANUEL	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	8 BUTUNOI GEORGE-MADALIN	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	9 CHILEA SALUCA-MARIA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:
10 CHERITOIU ECATERINA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:	11 COJOC MARIUS	<input checked="" type="checkbox"/> Puncte: 0 Nota: 0 Obs:	12 COJOCARI AURA-FLORINA	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:

Nr. Student	Prezent
2 <u>ANTIGHIN FLORIN-RAZVAN</u>	<input type="checkbox"/> Puncte: 0 Nota: 0 Obs:

Bonus (~0.5–4.15)

Disciplina: Optoelectronica, structuri, tehnologii, circuite
An: 2015/2016

Bonus-uri care se aplica la nota de la teza obtinute prin:

- prezenta la curs (0.5p / 3pr)
- 3 miniteste aplicate la curs (max. 3 X 1.5p)
- contributie la site rf-opto (foto <C5=1p, >C5=0.5p)

Nr.	Student	Grupa	Prezente curs	Bonus prezenta	Bonus foto	Bonus T1	Bonus T2	Bonus T3	Total Bonus	Obs.
1	CIOLPAN OCTAVIAN	5306	3	0.5					0.5	-
2	NITA COSTEL-CATALIN	5307	4	0.5	1				1.5	-
3	BARON BOGDAN-IONUT	5405	12	2	1	0.5		0.75	4.25	-

Prezenta

[Curs](#)
[Laborator](#)

Liste

[Studenti care nu pot intra in examen](#)
[Bonus-uri acumulate](#)

- ▶ **Minim** 7 prezente
- ▶ 0.5p/3prez
- ▶ 3 teste
- ▶ foto <C4/ <C6

Acces

- ▶ Personalizat (parola), Generic (email)



Date:

Grupa	5304 (2015/2016)
Specializarea	Tehnologii si sisteme de telecomunicatii
Marca	5184

[Acceseaza ca acest student](#)

Note obtinute

Disciplina	Tip	Data	Descriere	Nota	Puncte	Obs.
TW			Tehnologii Web			
N		17/01/2014	Nota finala	10	-	
A		17/01/2014	Colocviu Tehnologii Web 2013/2014	10	7.55	
B		17/01/2014	Laborator Tehnologii Web 2013/2014	9	-	
D		17/01/2014	Tema Tehnologii Web 2013/2014	9	-	

Login

Use the Registration no. and your

Registration no.

Email/Password

Write the code
below



Send

Parola

▶ primita prin **email**

Important message from RF-OPTO Inbox x

 **Radu-Florin Damian**
to me, POPESCU ▾

 Romanian ▾ > English ▾ [Translate message](#)

 Laboratorul de Microunde si Optoelectronica
Facultatea de Electronica, Telecomunicatii si Tehnologia Informatiei
Universitatea Tehnica "Gh. Asachi" Iasi

In atentie: POPESCU GOPO ION

Parola pentru a accesa examenele pe server-ul **rf-opto** este
Parola: 

Identificati-va pe [server](#), cu parola, cat mai rapid, pentru confirmare.

Memorati acest mesaj intr-un loc sigur, pentru utilizare ulterioara

Attention: POPESCU GOPO ION

The password to access the exams on the **rf-opto** server is
Password: 

Login to the [server](#), with this password, as soon as possible, for confirmation.

Save this message in a safe place for later use

 Reply  Reply all  Forward

Subject

Correspondents

Important message from RF-OPTO * ⇒ POPESCU GOPO ION

Validation of MDCK exam from 02/05/2020

From Me <rdamian@etti.tuiasi.ro> ★

Subject **Important message from RF-OPTO**

To 

Cc Me <rdamian@etti.tuiasi.ro> ★

 Laboratorul de Microunde si Optoelectronica
Facultatea de Electronica, Telecomunicatii si Tehnologia Informatiei
Universitatea Tehnica "Gh. Asachi" Iasi

In atentie: POPESCU GOPO ION

Parola pentru a accesa examenele pe server-ul **rf-opto** este
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Manual examen online

- ▶ Aplicatia de examen online utilizata la:
 - ~~curs (prezenta)~~
 - ~~miniteste~~
 - ~~examen~~

Materials

Other data

[Manual examen on-line](#) (pdf, 2.65 MB, ro, 🇷🇴)

[Simulare Examen](#) (video) (mp4, 65.12 MB, ro, 🇷🇴)

Microwave Devices and Circuits (Englis

Examen online

- ▶ intotdeauna **contratimp**
 - perioada lunga (prezenta curs/fotografii)
 - ~~perioada scurta (teste: 15min, examen: 2h)~~

Start Didactic Master Colectiv Cercetare **Studenti**

Note Lista Studenti **Examene** Fotografii

Anunț
17:28 (29/04/2020)

Material suport
17:30 (29/04/2020)

Subiecte
17:32 (29/04/2020)

Rezultate
17:35 (29/04/2020)

Finalizare
17:45 (29/04/2020)

Confirmare
17:45 (30/04/2020)

Urmatorul interval de timp in:
01 m 08 s
[Reincarca acum](#)

Anunț

In acest examen se verifica diverse actiuni ale studentilor pentru examen

Ora pe server

Toate examenele sunt bazate pe fusul orar al server-ului (ar putea sa fie diferit de timpul local). Pentru referinta ora pe server este acum:

29/04/2020 17:28:51

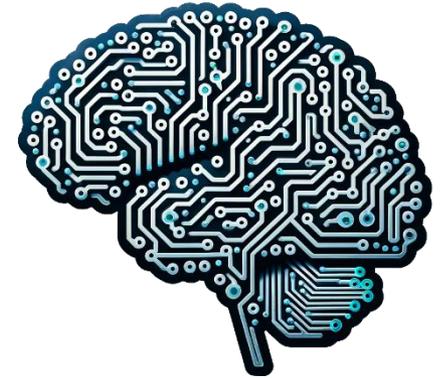
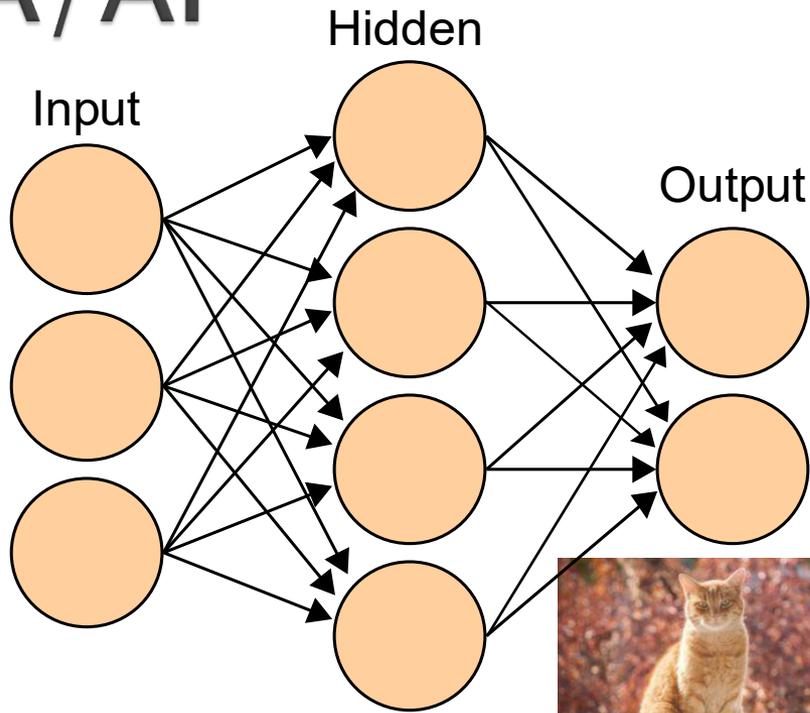
Scop 4



**Sinapse
“ingineresti”**



IA/AI



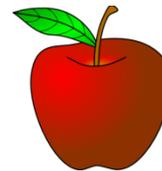
Calculul atenuarii/amplificarii

$$\text{Atenuare/Amplificare} = \frac{P_{out}}{P_{in}}$$

$$\text{Atenuare[dB]} = [-] 10 \cdot \log_{10} \left(\frac{P_{out}}{P_{in}} \right)$$

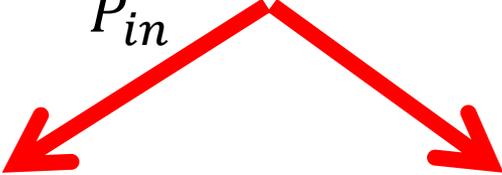
$$\text{Atenuare[dB]} = [-] 10 \cdot \log_{10} \left(\frac{P_{out}}{P_0} \cdot \frac{P_0}{P_{in}} \right) = [-] 10 \cdot \left[\log_{10} \left(\frac{P_{out}}{P_0} \right) - \log_{10} \left(\frac{P_{in}}{P_0} \right) \right]$$

$$\text{Pierderi[dB]} = [-] (P_{out} [\text{dBm}] - P_{in} [\text{dBm}])$$



Calculul atenuarii/amplificarii

$$\text{Atenuare} = \frac{P_{out}}{P_{in}} < 1 \quad \text{Pierderi[dB]} = 10 \cdot \log_{10} \left(\frac{P_{out}}{P_{in}} \right) < 0$$


$$\text{Pierderi/Atenuare[dB]} = [-] 10 \cdot \log_{10} \left(\frac{P_{out}}{P_{in}} \right)$$

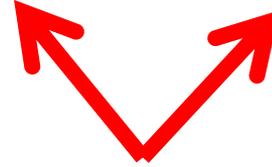
$$\text{Castig} = \frac{P_{out}}{P_{in}} > 1 \quad \text{Castig[dB]} = 10 \cdot \log_{10} \left(\frac{P_{out}}{P_{in}} \right) > 0$$

$$\text{Atenuare[dB/km]} = \frac{\text{Pierderi[dB]}}{\text{Lungime[km]}}$$

Calculul atenuarii/amplificarii

Pierderi/Atenuare $\rightarrow P_{out} < P_{in} \rightarrow P_{out}[\text{dBm}] < P_{in}[\text{dBm}]$

$$P_{out}[\text{dBm}] = P_{in}[\text{dBm}] - \text{Pierderi/Atenuare}[\text{dB}]$$



Castig/Amplificare $\rightarrow P_{out} > P_{in} \rightarrow P_{out}[\text{dBm}] > P_{in}[\text{dBm}]$

$$P_{out}[\text{dBm}] = P_{in}[\text{dBm}] + \text{Castig/Amplificare}[\text{dB}]$$



Introducere

Capitolul 1

Aplicatii majore

- ▶ Comunicatii
 - Infrarosu (InGaAsP)
- ▶ Vizibil
 - Spectru vizibil (GaAlAs)
- ▶ Iluminare
 - Putere ridicata, lumina alba (GaInN)
- ▶ Energie solara
 - Efect fotovoltaic (Si)

Aplicatii majore

▶ Comunicatii

- Infrarosu (InGaAsP)

▶ Vizibil

- Spectru vizibil (GaAlAs)

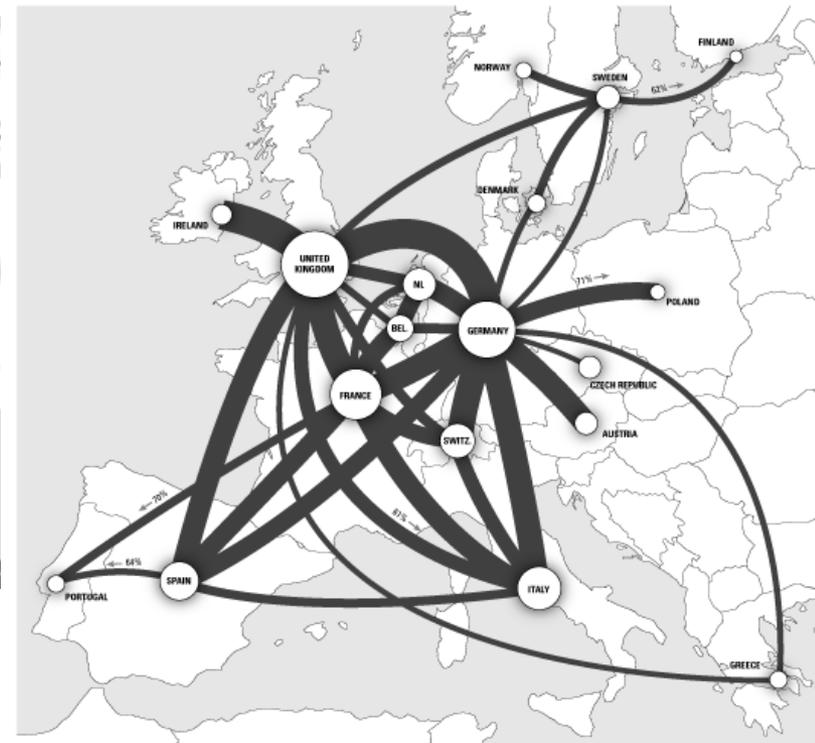
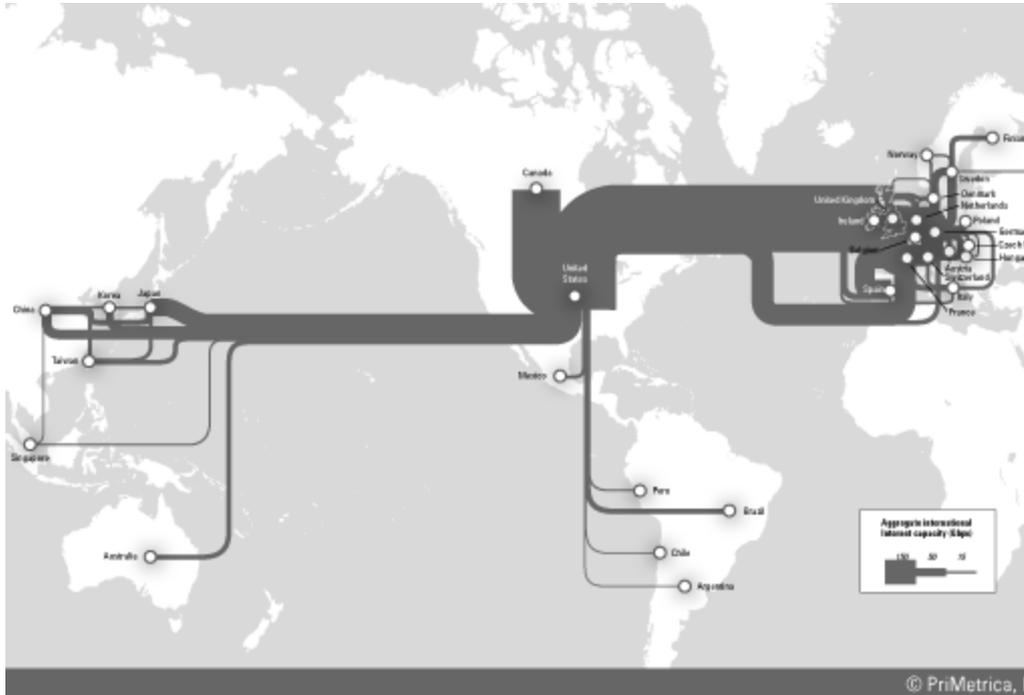
▶ Iluminare

- Putere ridicata, lumina alba (GaInN)

▶ Energie solara

- Efect fotovoltaic (Si)

Internet Backbone



Key

All figures are given in millions of minutes of telecommunications traffic for the public telephone network.

The map shows all intra-European routes with a combined 2004 volume of more than 900 million minutes.

Traffic Flows



Each band is proportional to the total annual traffic on the public telephone network in both directions between each pair of countries.

Total Outgoing Traffic



The area of each circle is proportional to the volume of the total annual outgoing traffic from each country.

Balance of Traffic

On routes where traffic in one direction accounts for more than 80 percent of the total, an arrow shows the direction most of the traffic flows.

Aplicatii majore

- ▶ Comunicatii
 - Infrarosu (InGaAsP)
- ▶ Vizibil
 - Spectru vizibil (GaAlAs)
- ▶ Iluminare
 - Putere ridicata, lumina alba (GaInN)
- ▶ Energie solara
 - Efect fotovoltaic (Si)

Spectru vizibil



Aplicatii majore

- ▶ Comunicatii
 - Infrarosu (InGaAsP)
- ▶ Vizibil
 - Spectru vizibil (GaAlAs)
- ▶ Illuminare
 - Putere ridicata, lumina alba (GaInN)
- ▶ Energie solara
 - Efect fotovoltaic (Si)

Aplicatii



Aplicatii majore

- ▶ Comunicatii
 - Infrarosu (InGaAsP)
- ▶ Vizibil
 - Spectru vizibil (GaAlAs)
- ▶ Iluminare
 - Putere ridicata, lumina alba (GaInN)
- ▶ Energie solara
 - Efect fotovoltaic (Si)

Aplicatii



Aplicatii majore

▶ Comunicatii

- Infrarosu (InGaAsP)

▶ Vizibil

- Spectru vizibil (GaAlAs)

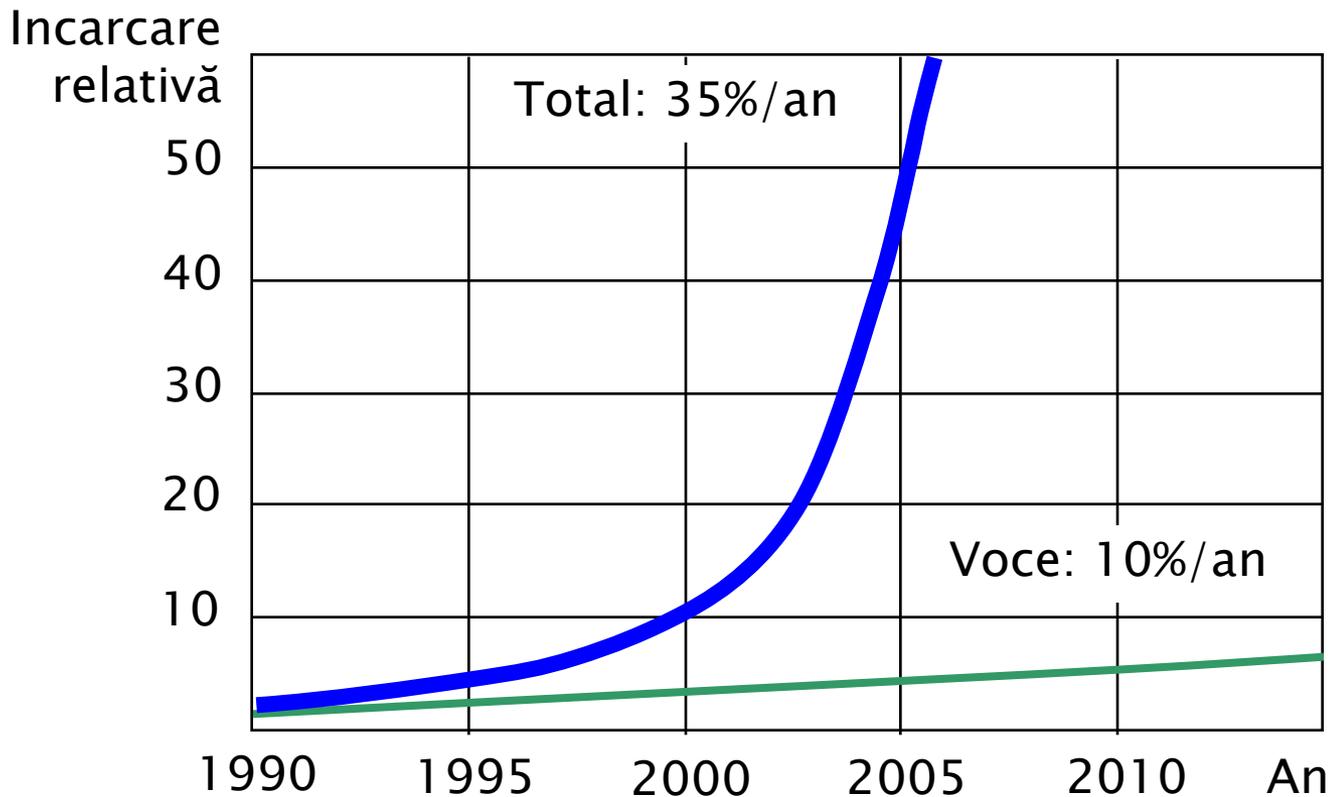
▶ Iluminare

- Putere ridicata, lumina alba (GaInN)

▶ Energie solara

- Efect fotovoltaic (Si)

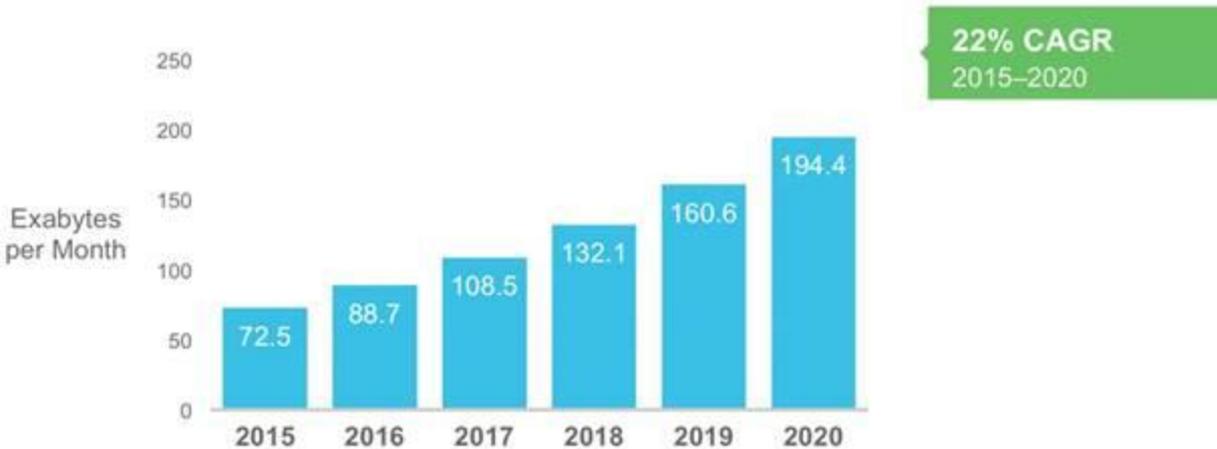
Evoluția lățimii de bandă utilizată în rețelele de telecomunicații



Sursa:

EC ELECTRONICAST
CORPORATION

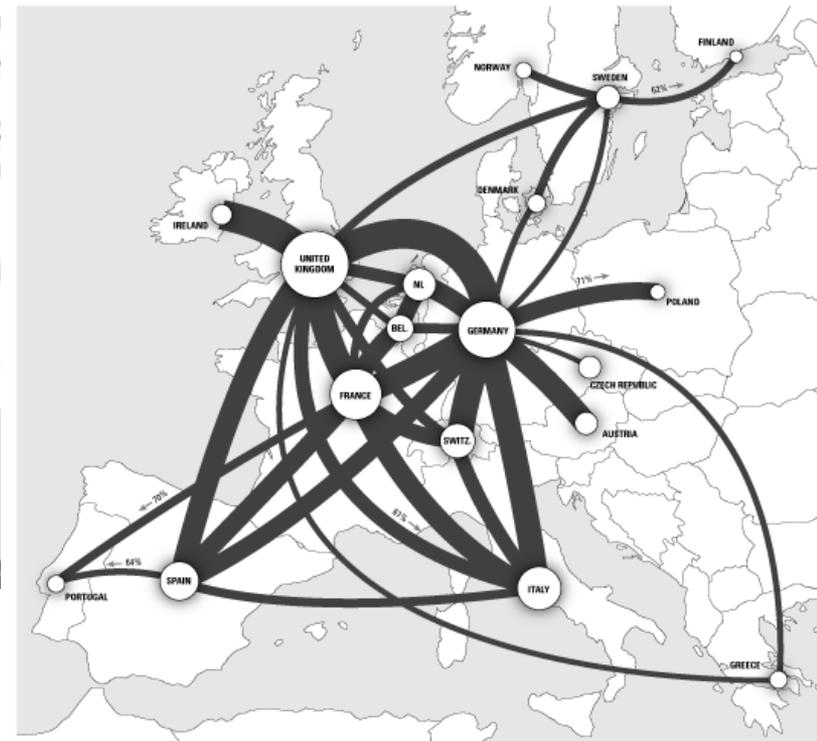
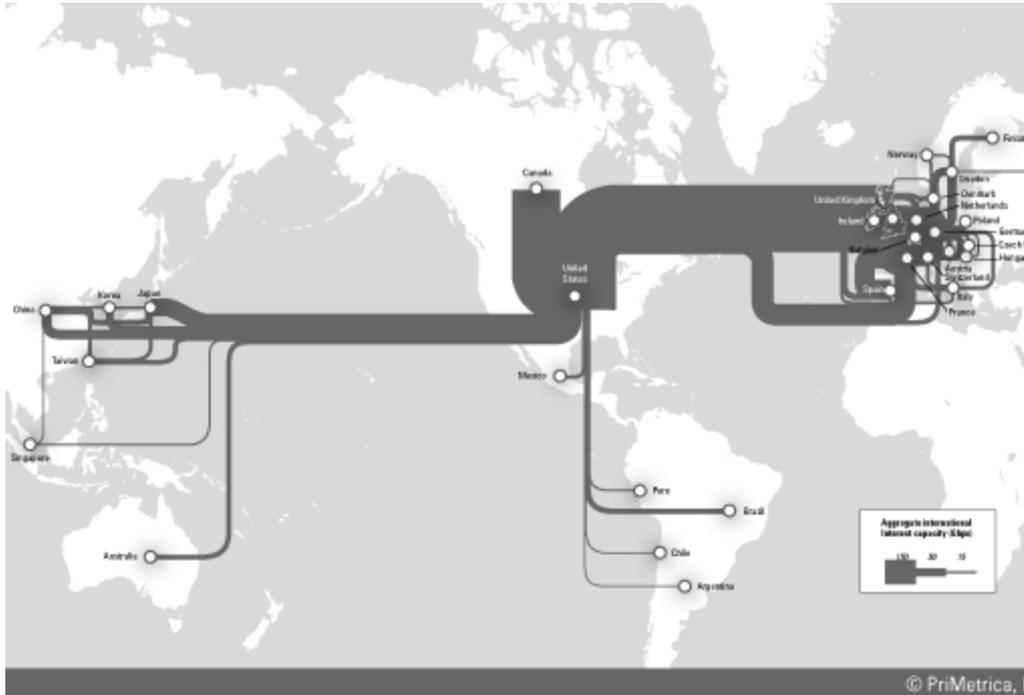
Evoluția lățimii de bandă



Source: Cisco VNI, 2016

Year	Global Internet Traffic
1992	100 GB per day
1997	100 GB per hour
2002	100 GBps
2007	2,000 GBps
2015	20,235 GBps
2020	61,386 GBps

Internet Backbone



Key

All figures are given in millions of minutes of telecommunications traffic for the public telephone network.

The map shows all intra-European routes with a combined 2004 volume of more than 900 million minutes.

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Internet Backbone



Avantajele comunicațiilor prin fibra optică – 1

- ▶ Greutate și volum
- ▶ Costul materialelor primare
 - SiO_2/Cu
- ▶ Capacitate de transmisie a informației **$f \sim 200\text{THz}$**
 - 15.5 Tbit/s @ 7000 km, 69.1 Tb/s @ 240km
 - 159 Tb/s @ 1045 km
 - Banda (Viteza) x Distanță [MHz · km] [? MHz/km]
- ▶ Lipsa conexiunilor electrice
 - Bucle de masă (1–2V/km)
 - Siguranță în exploatare
 - Imunitate la fulgere/lipsa scânteilor

Avantajele comunicațiilor prin fibra optică – 2

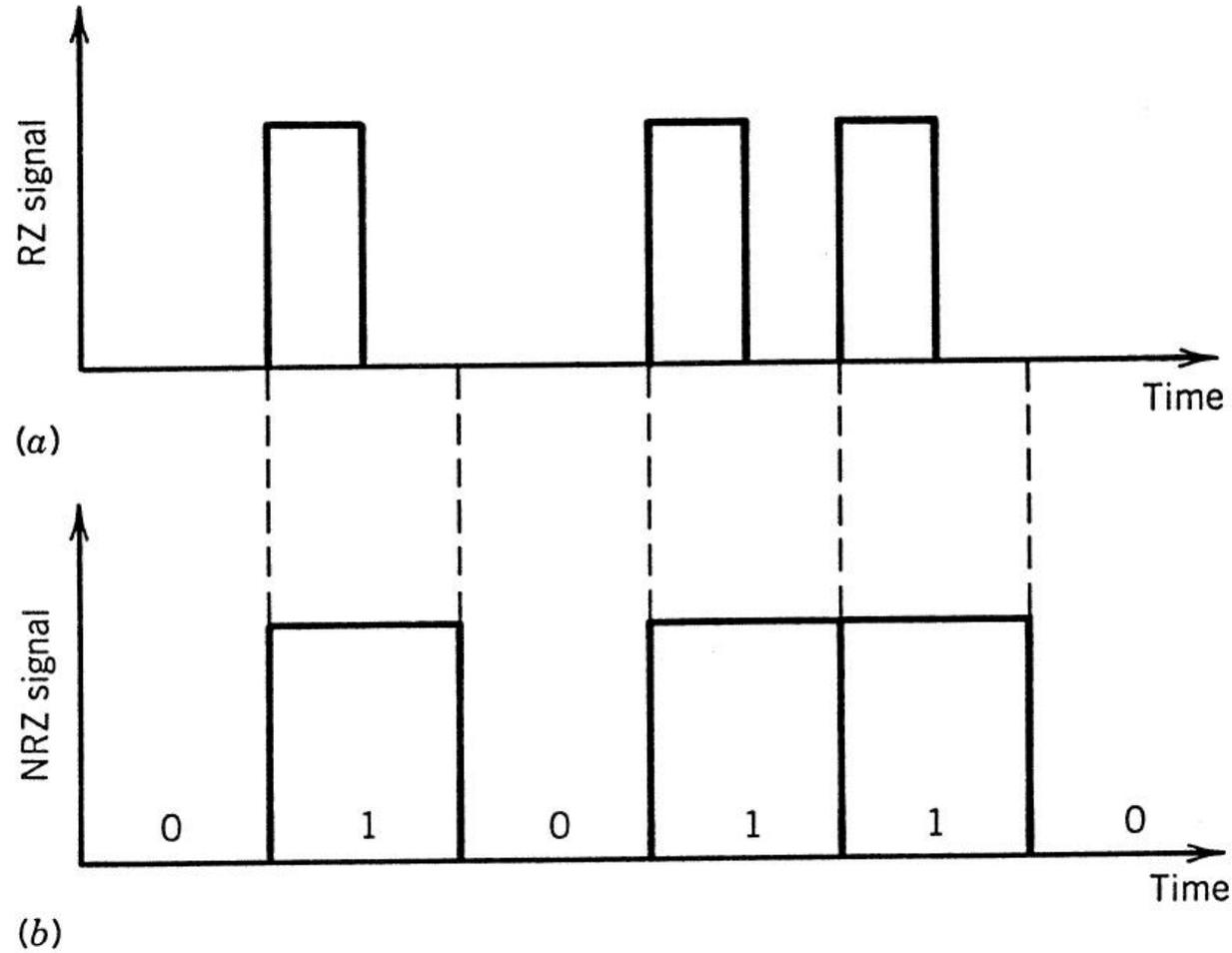
- ▶ Imunitate la interferență electromagnetică
- ▶ Distanța între repeatoare
 - 100km/2–5km
- ▶ Posibilitate de creștere a capacității de transmisie a informației
 - Teoretic extrem de mare (aproape infinită) **$f \sim 200\text{THz}$**
 - Reutilizarea cablurilor existente
- ▶ Securitate
 - Interceptare dificilă și detectabilă
 - Inserare de semnal practic imposibilă

Dezavantajele comunicațiilor prin fibra optică

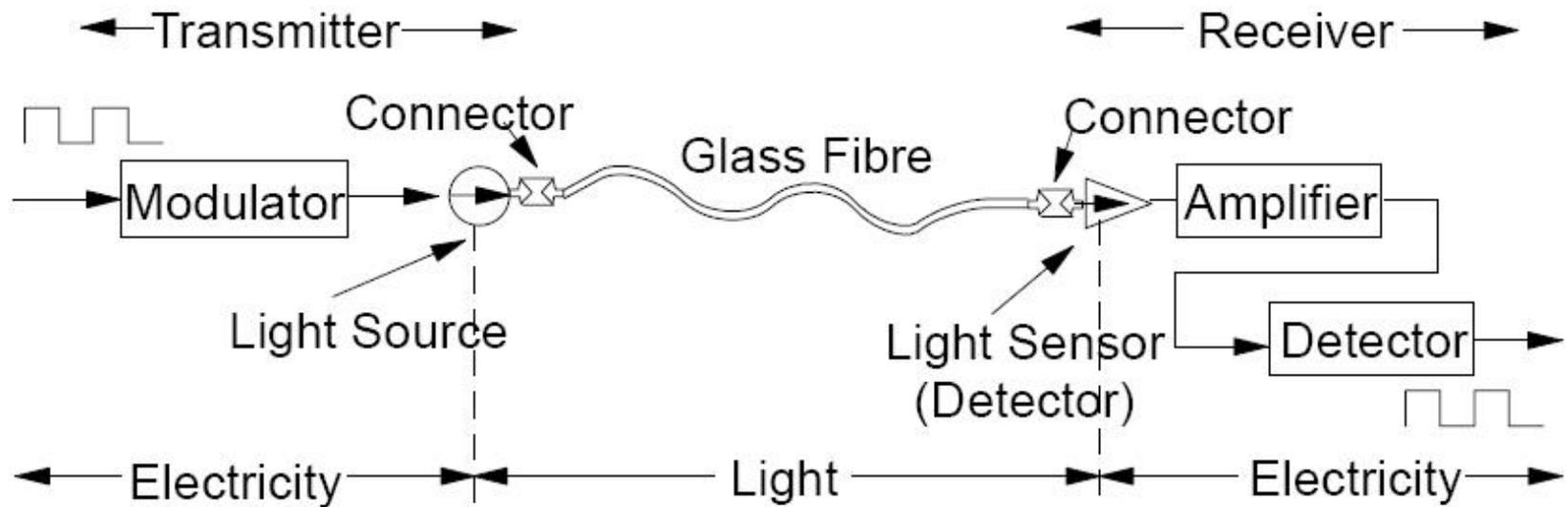
- ▶ Conexiuni complexe și esențiale
 - Costul circuitelor integrate crescut considerabil de cuplarea luminii în fibra
- ▶ Curbarea cablurilor optice
- ▶ Dezvoltarea greoaie a standardelor
- ▶ Optica folosită strict pentru transmisie (aproape)
 - EDFA – Erbium Doped Fiber Amplifier
- ▶ Sensibilitate la radiații gama și câmpuri electrice intense
- ▶ Rozătoare și termite

Modulare

- ▶ return-to-zero (RZ)
- ▶ nonreturn-to-zero (NRZ)

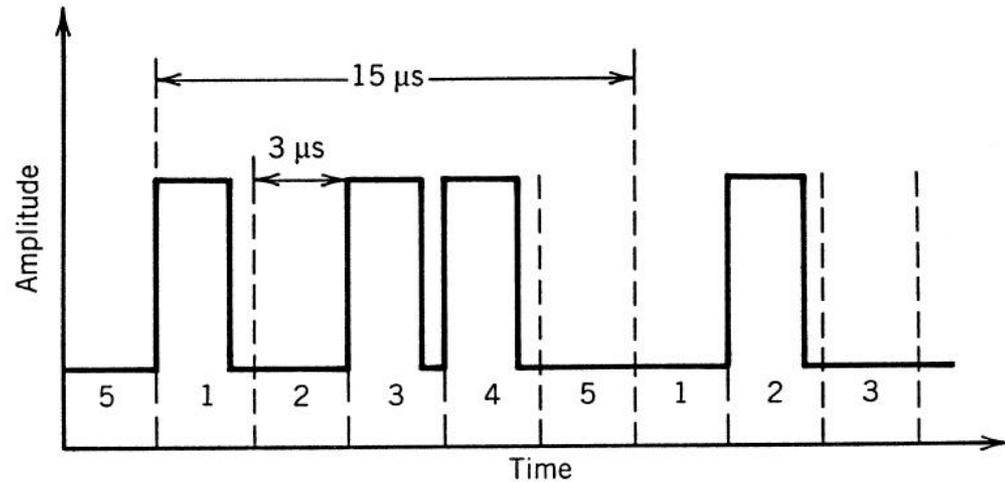


Transmisia optica

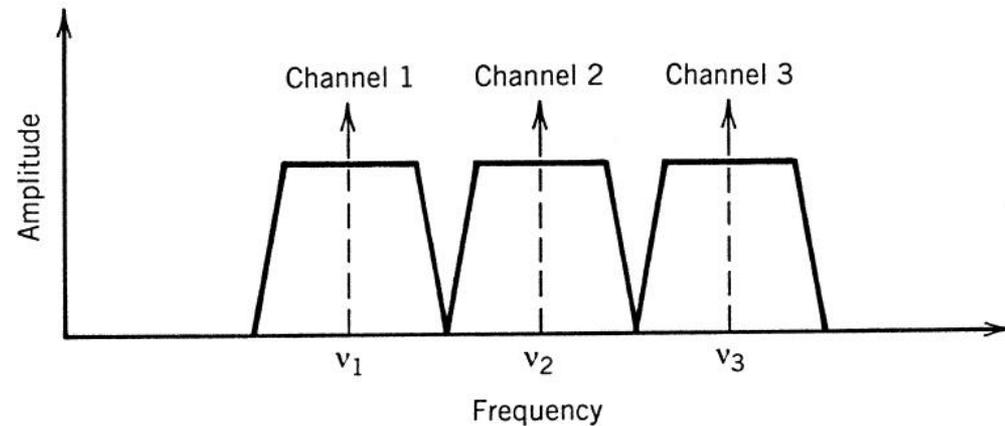


Multiplexare

- ▶ TDM
 - time-division multiplexing
- ▶ FDM
 - frequency-division multiplexing
- ▶ Realizabila in domeniul **electric/optic**
- ▶ WDM
 - wavelength division multiplexing

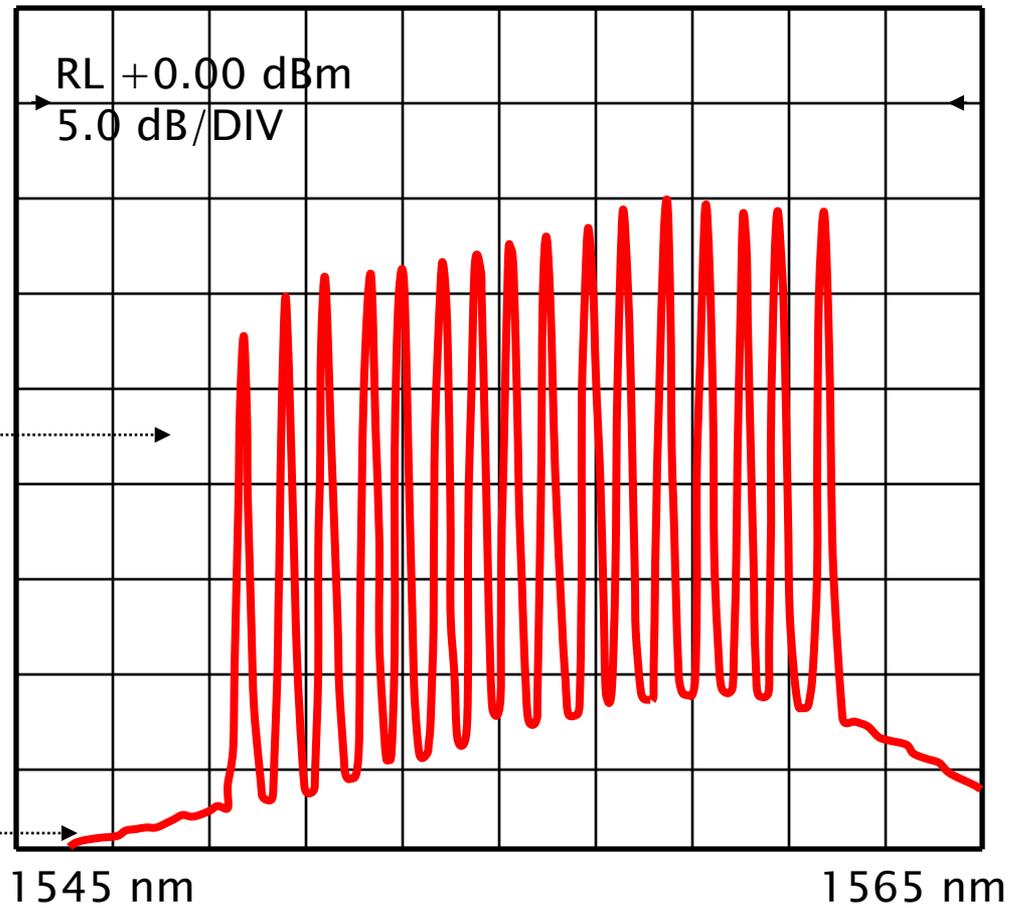


(a)



(b)

Spectrul WDM – Wavelength Division Multiplexing



Canale: 16
Spațiere: 0.8 nm

Emisie spontană
Amplificată (ASE)

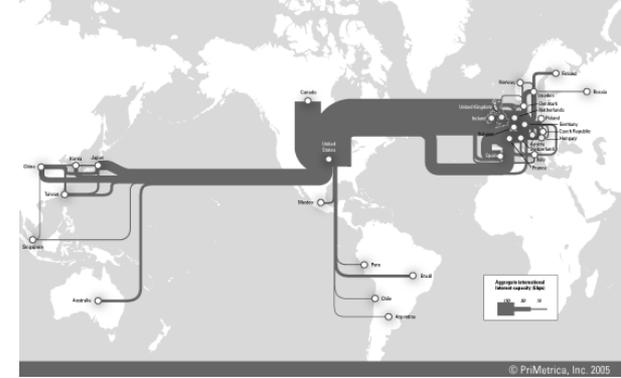
Standardde

- ▶ SUA, Japonia

SONET	SDH	B (Mb/s)	Channels
OC-1		51.84	672
OC-3	STM-1	155.52	2,016
OC-12	STM-4	622.08	8,064
OC-48	STM-16	2,488.32	32,256
OC-192	STM-64	9,953.28	129,024
OC-768	STM-256	39,813.12	516,096

- ▶ SONET – synchronous optical network
 - ▶ inlocuit de
- ▶ SDH – synchronous digital hierarchy

Standard



▶ SUA

STS-1 and OC-1	51.840 Mb/s	
STS-3 and OC-3	155.52 Mb/s	same as STM-1
STS-9 and OC-9	466.56 Mb/s	
STS-12 and OC-12	622.08 Mb/s	same as STM-4
STS-18 and OC-18	933.12 Mb/s	
STS-24 and OC-24	1244.16 Mb/s	same as STM-8
STS-36 and OC-36	1866.24 Mb/s	
STS-48 and OC-48	2488.32 Mb/s	same as STM-16
STS-192 and OC-192	9953.28 Mb/s	same as STM-64
STS-256 and OC-256	13271.04 Mb/s	same as STM-86
STS-768 and OC-768	39813.12 Mb/s	same as STM-256
STS-3072 and OC-3072	159252.48 Mb/s	same as STM-1024
STS-12288 and OC-12288	639009.92 Mb/s	same as STM-4096

▶ Europa

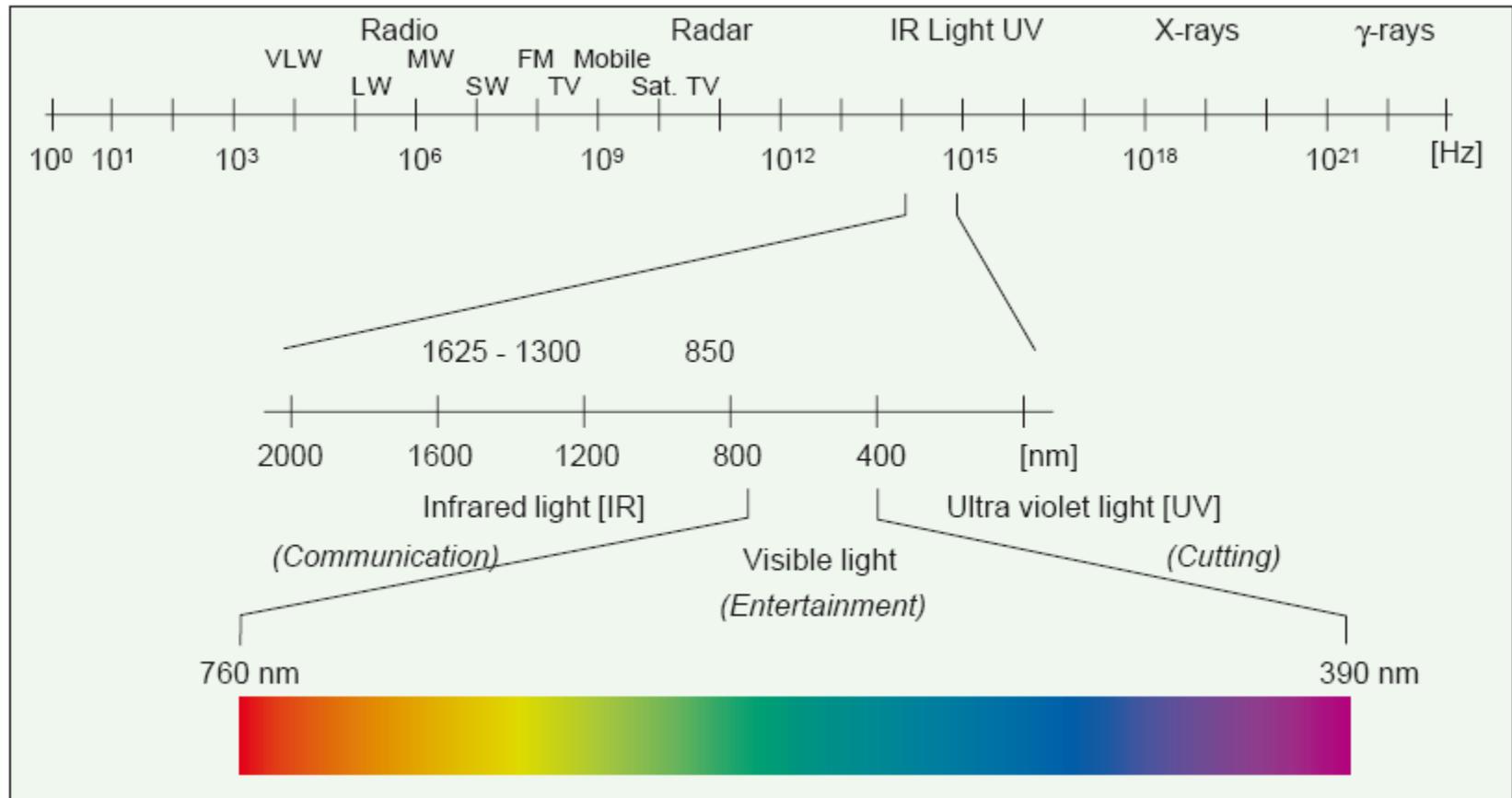
E0	64 Kb/s	
E1	2.048 Mb/s	
E2	8.448 Mb/s	4 E1s
E3	34.364 Mb/s	16 E1s
E4	139.264 Mb/s	64 E1s

1 mile = 1760 yards

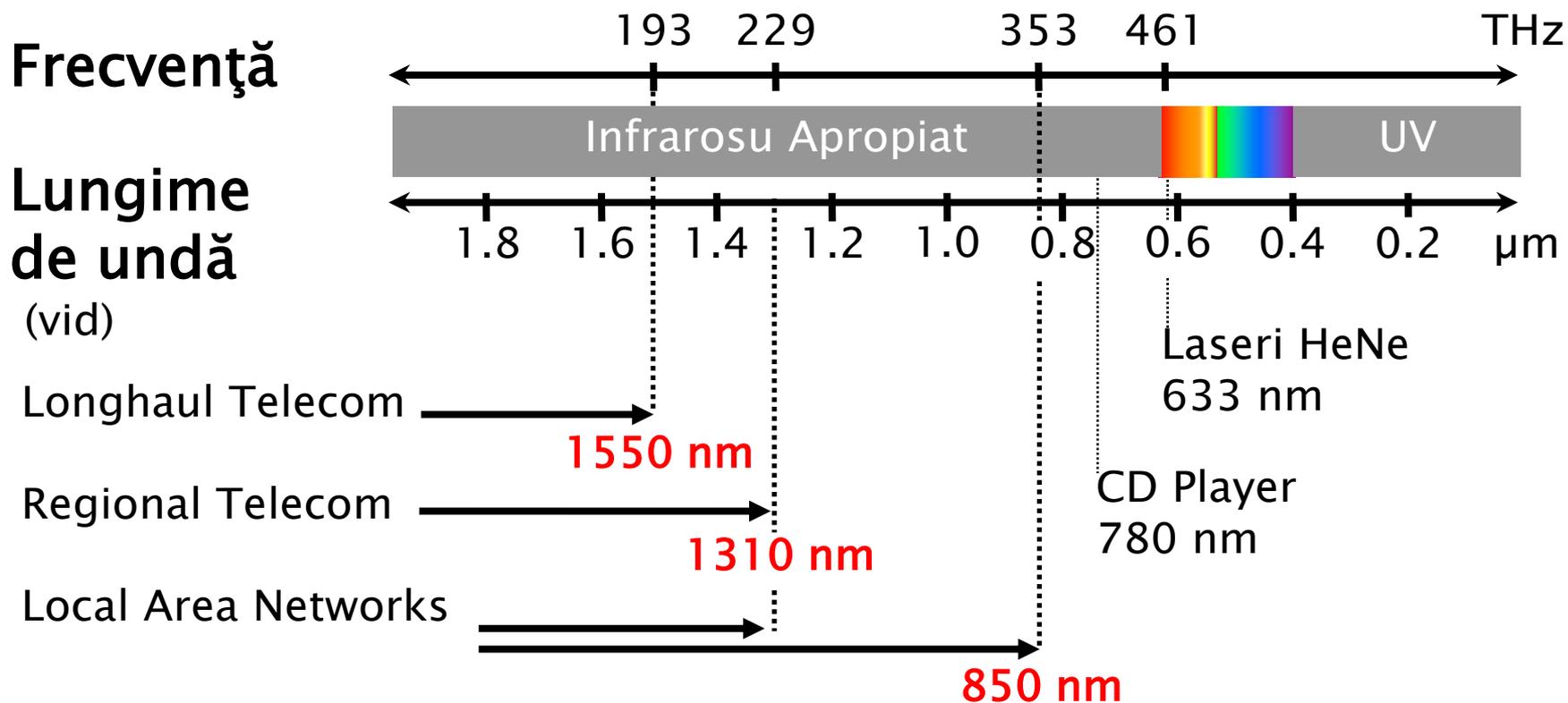
1 yards = 3 feet

1 mile ≈ 1609.34 m

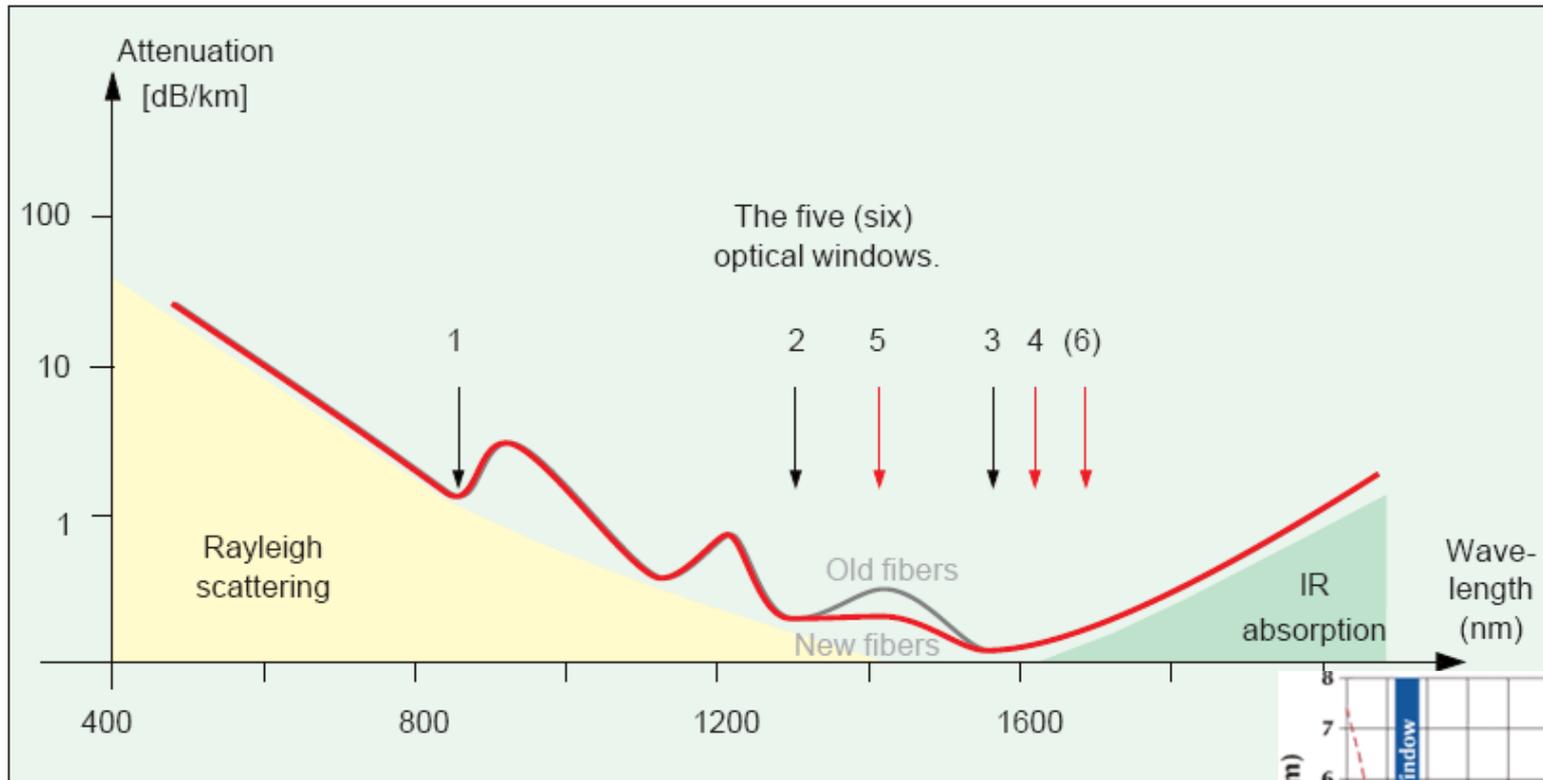
Spectrul electromagnetic



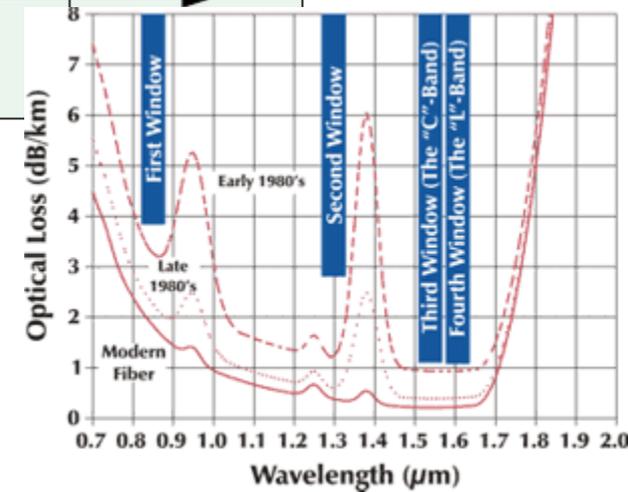
Benzi de lucru in comunicațiile optice



Atenuarea în fibra optică (SiO₂)



850nm, 1310nm, 1550nm



Aplicatii majore

- ▶ Comunicatii
 - Infrarosu (InGaAsP)
- ▶ Vizibil
 - Spectru vizibil (GaAlAs)
- ▶ Iluminare
 - Putere ridicata, lumina alba (GaInN)
- ▶ Energie solara
 - Efect fotovoltaic (Si)

Eficiența

- ▶ Bec cu incandescenta
 - 16 lm/W
- ▶ Tub fluorescent
 - 100 lm/W
- ▶ LED
 - curent: 250 lm/W
 - curand: 300 lm/W

Premiul Nobel, Fizica, 2014

Physics



The Nobel Prize in Physics 2014

Summary



The Nobel Prize in Physics 2014

Isamu Akasaki
Hiroshi Amano
Shuji Nakamura

Share this



The Nobel Prize in Physics 2014



© Nobel Media AB. Photo: A. Mahmoud

Isamu Akasaki

Prize share: 1/3



© Nobel Media AB. Photo: A. Mahmoud

Hiroshi Amano

Prize share: 1/3



© Nobel Media AB. Photo: A. Mahmoud

Shuji Nakamura

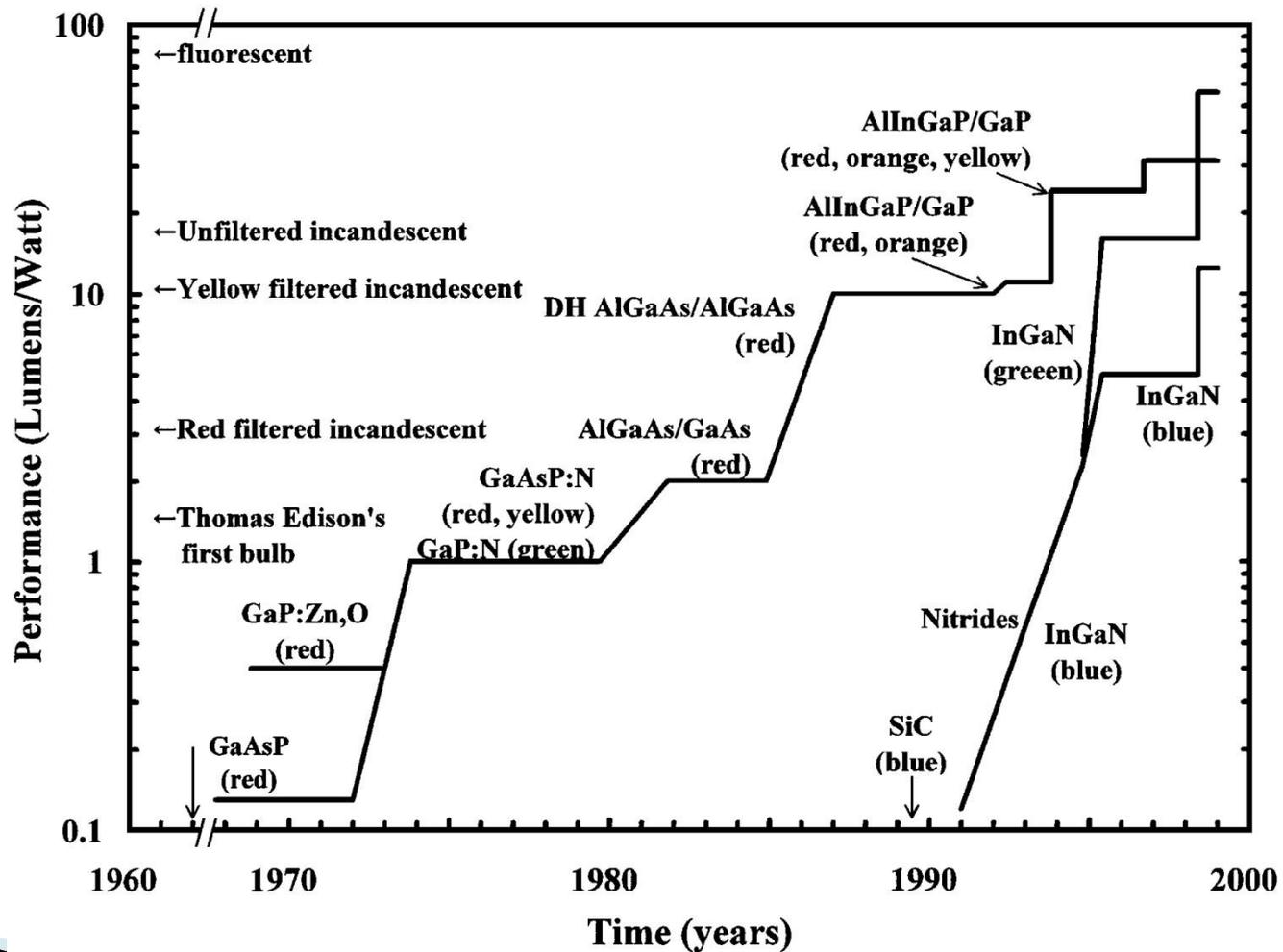
Prize share: 1/3

The Nobel Prize in Physics 2014 was awarded jointly to Isamu Akasaki, Hiroshi Amano and Shuji Nakamura "for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources."

To cite this section

MLA style: The Nobel Prize in Physics 2014, NobelPrize.org, Nobel Media AB 2021. Tue, 2 Mar 2021.

Eficienta in timp



Aplicatii

▶ auto



Aplicatii

- ▶ casnic

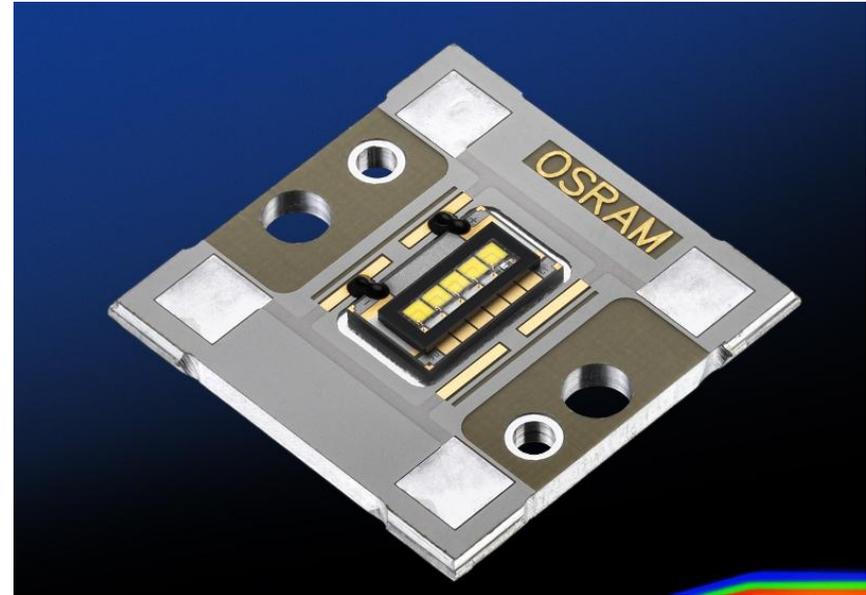


Aplicatii

- ▶ iluminat public



Aplicatii



Aplicatii majore

- ▶ Comunicatii
 - Infrarosu (InGaAsP)
- ▶ Vizibil
 - Spectru vizibil (GaAlAs)
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- ▶ Energie solara
 - Efect fotovoltaic (Si)

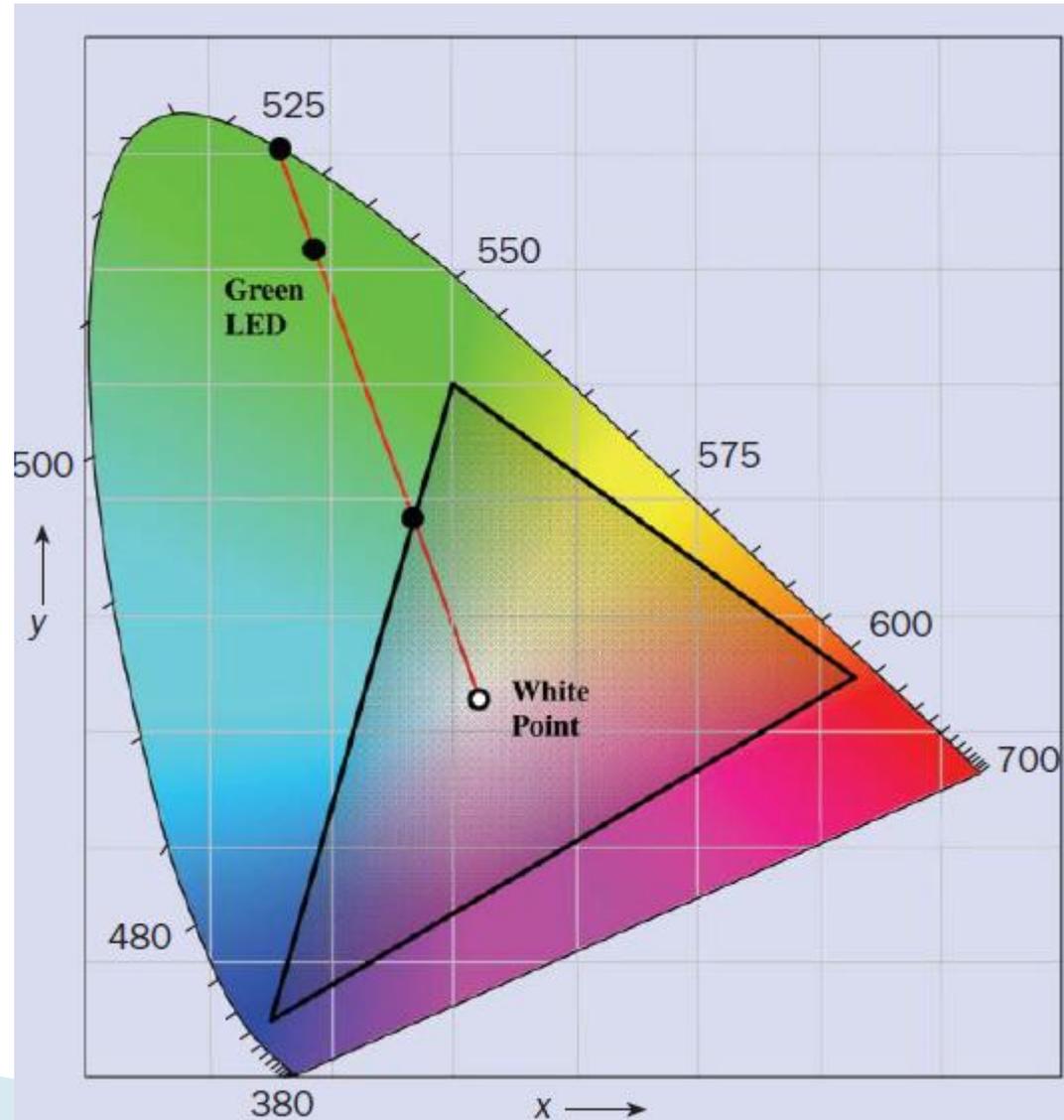
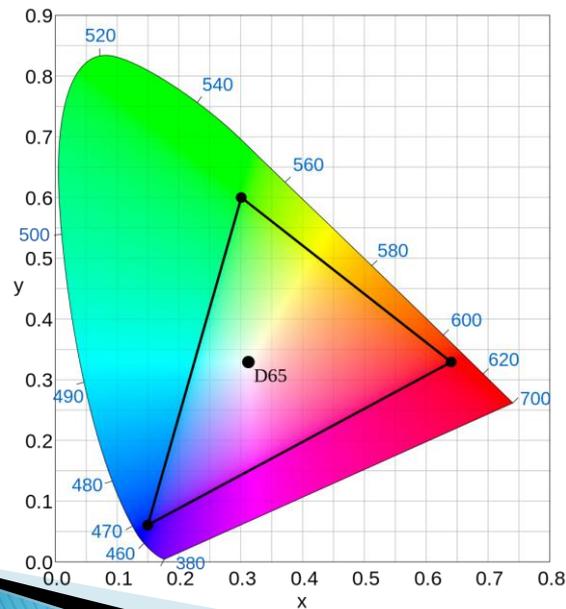
ITU-R BT.709



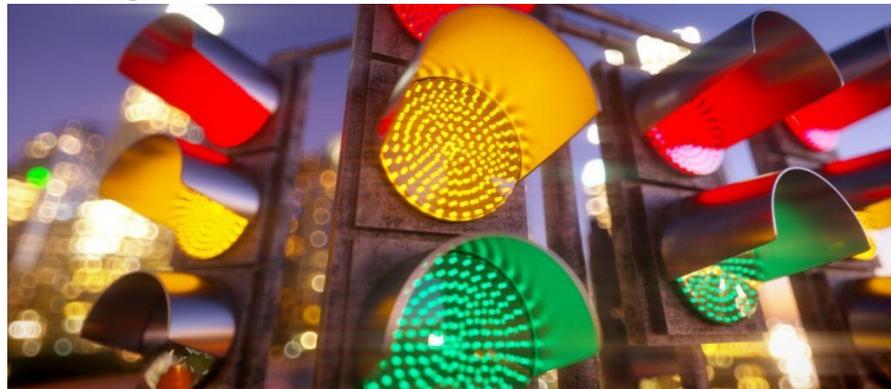
ITU-R BT.709 phosphor properties

Phosphor	x	y
Red	0.640	0.330
Green	0.300	0.600
Blue	0.150	0.060

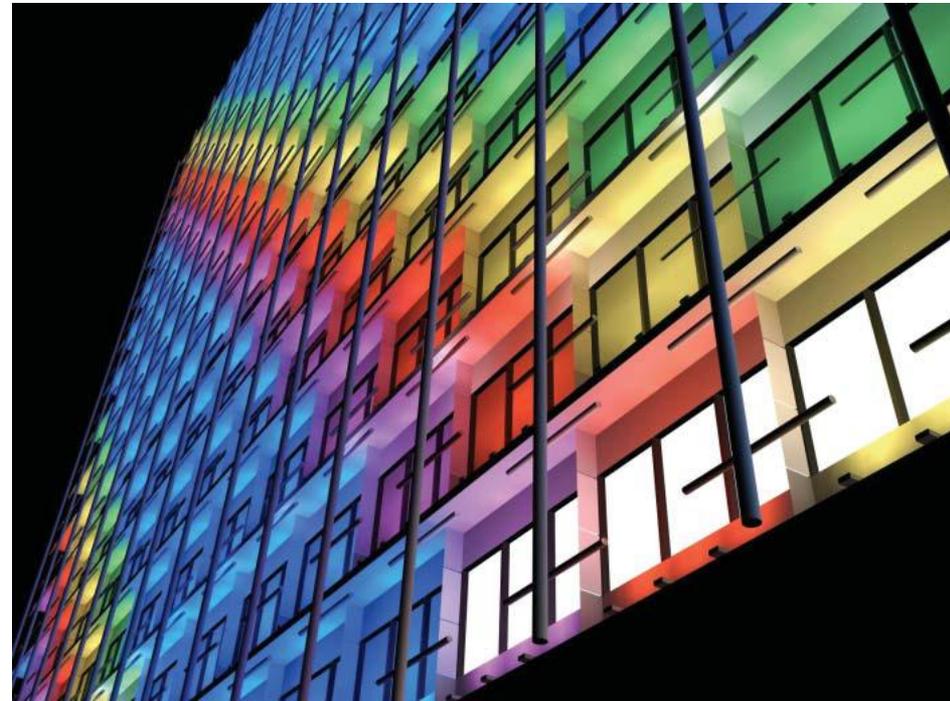
Data refers to xy chromaticity co-ordinates of ITU-R BT.709 phosphors which are used in most CRT displays [1].



Spectru vizibil



ITU-R BT.709



RGB values for Luxeon LEDs

LED color	Dominant wavelength λ_D (nm)	RGB values
Royal blue	455	0.05, 0.00, 0.95
Blue	470	0.00, 0.11, 0.89
Cyan	505	0.00, 0.63, 0.37
Green	530	0.00, 0.77, 0.23
Amber	590	0.70, 0.30, 0.00
Red-orange	615	0.97, 0.00, 0.03
Red	625	0.92, 0.00, 0.08

Aplicatii majore

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 - Efect fotovoltaic (Si)

Aplicatii



Greta Thunberg



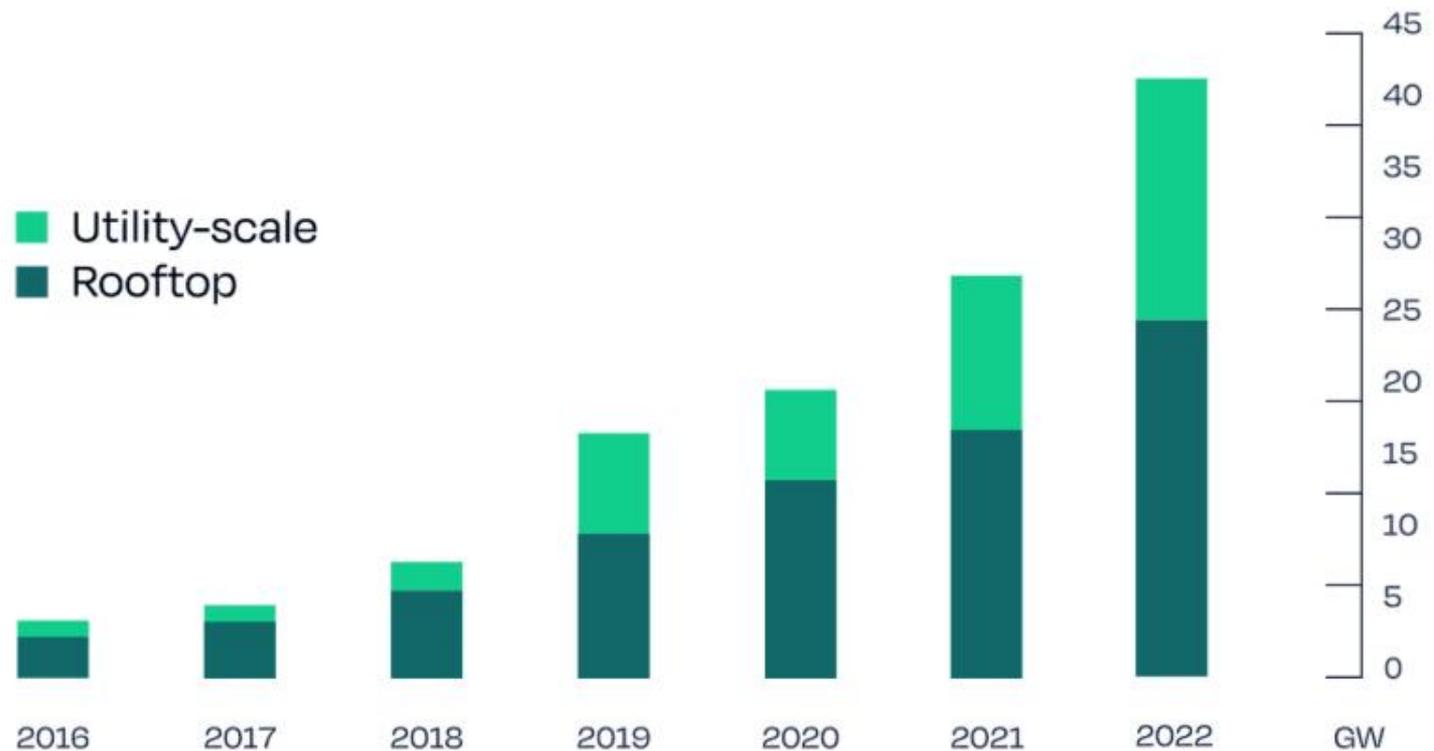
EU

Top 10 EU countries solar capacity per capita 2022



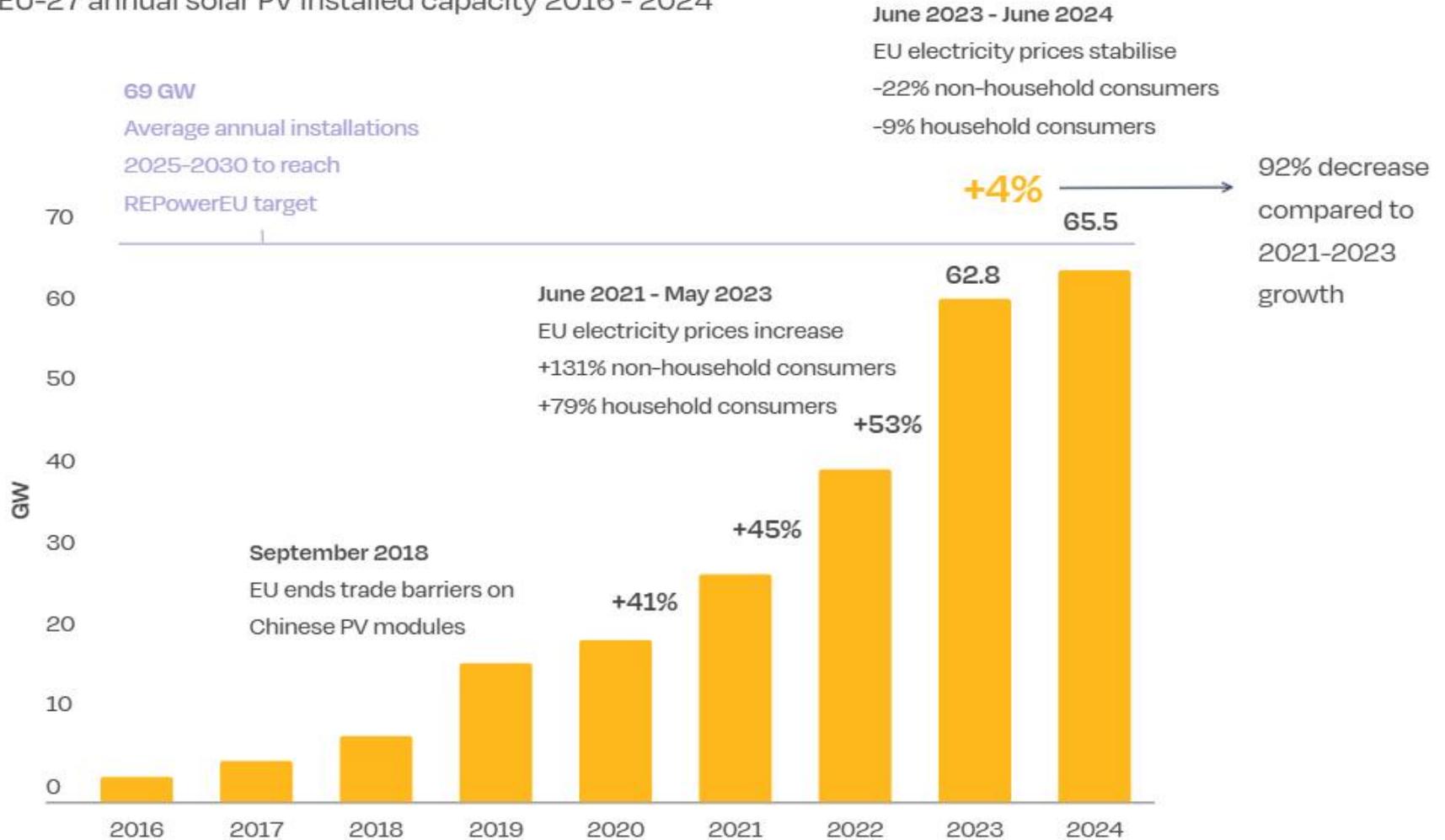
EU

Annual rooftop and utility scale installations in the EU



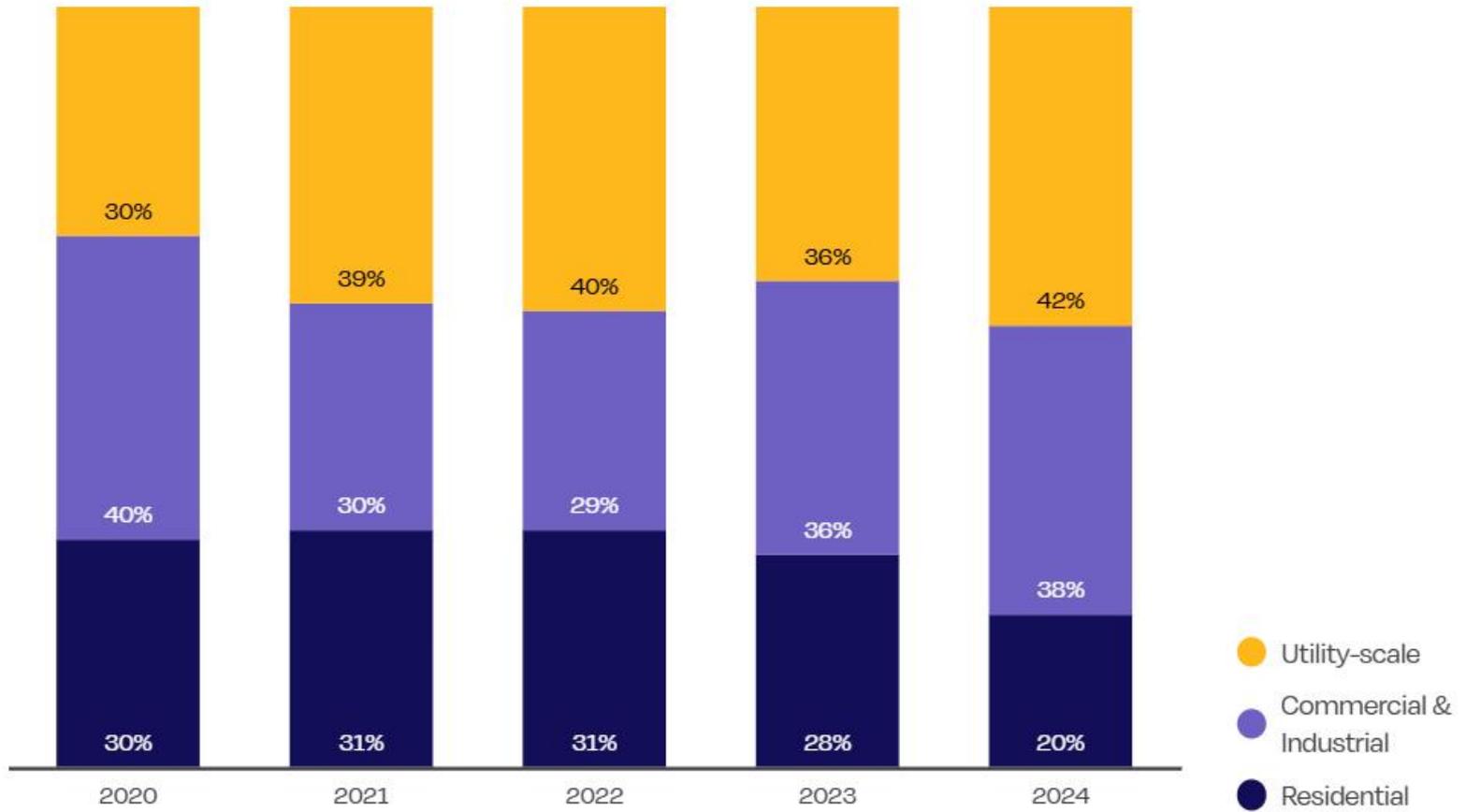
EU

EU-27 annual solar PV installed capacity 2016 - 2024



EU

EU-27 annual solar PV segmentation 2020-2024 (%)

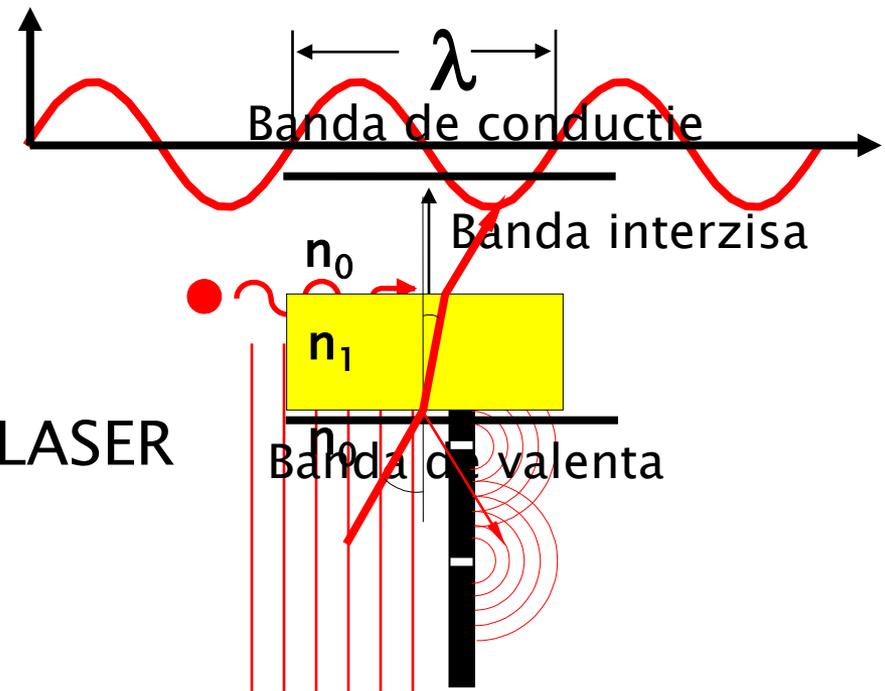


Modelarea luminii

(tot) Capitolul 1

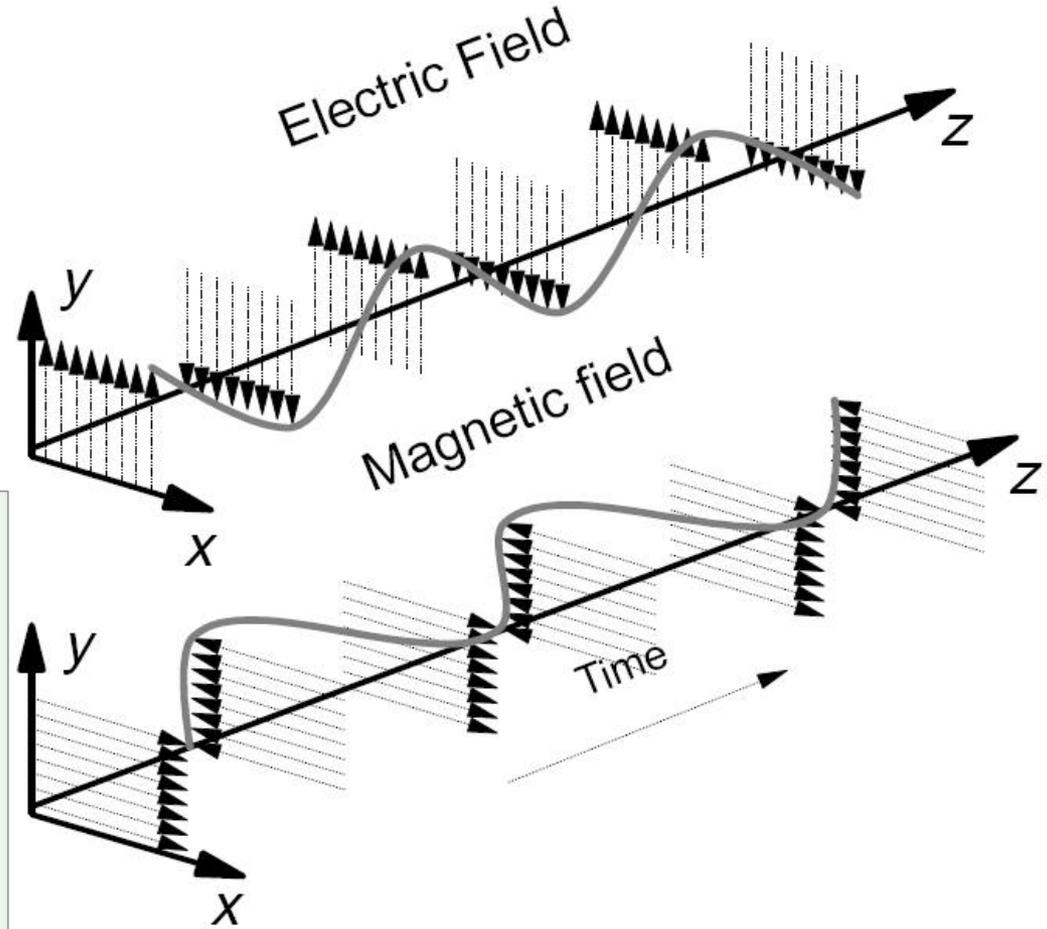
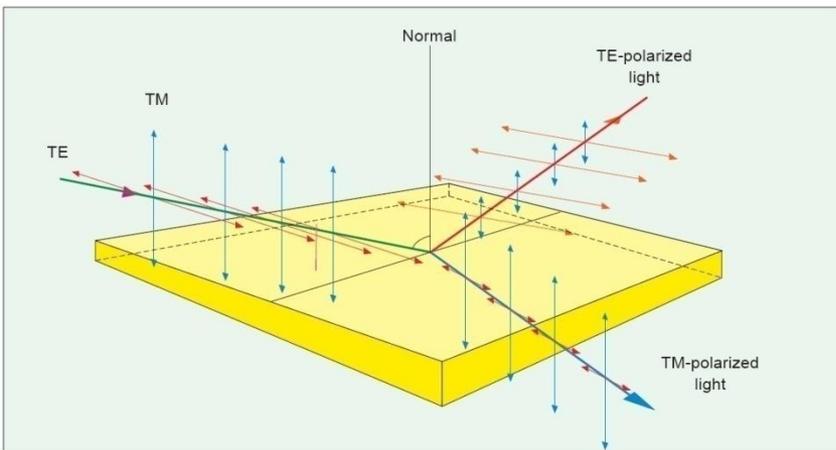
Modelarea luminii

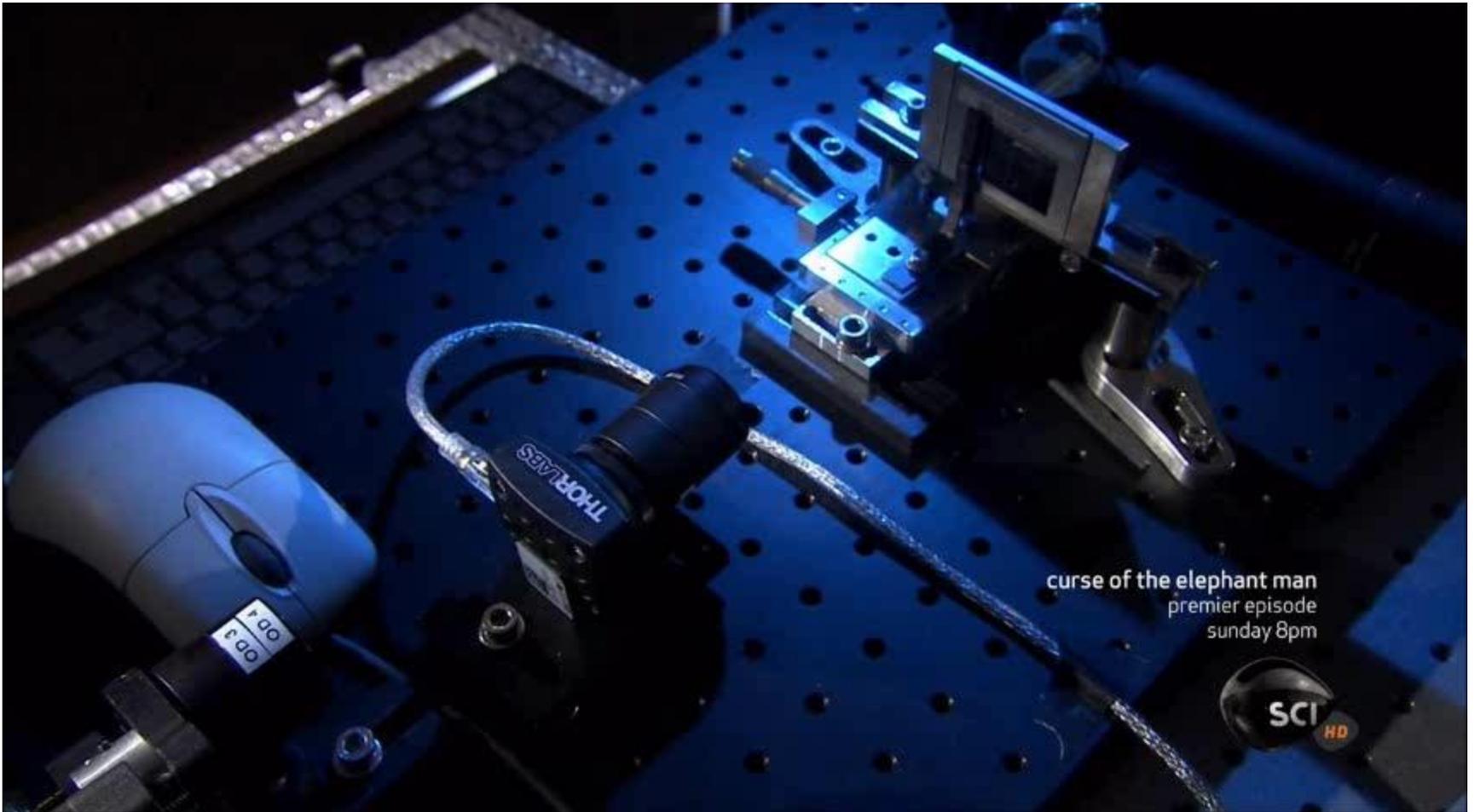
- ▶ Undă electromagnetică
 - Ecuațiile lui Maxwell
 - λ , ϵ , ω , f
- ▶ Teoria cuantică
 - Benzi energetice $E = h \nu$
 - fotoni, emisie stimulată, LASER
- ▶ Optică geometrică
 - n , θ
 - raze de lumină
 - intuitivă



Unda electromagnetica

- ▶ Dispersie
- ▶ Fibre monomod
- ▶ Interferenta
- ▶ Polarizare



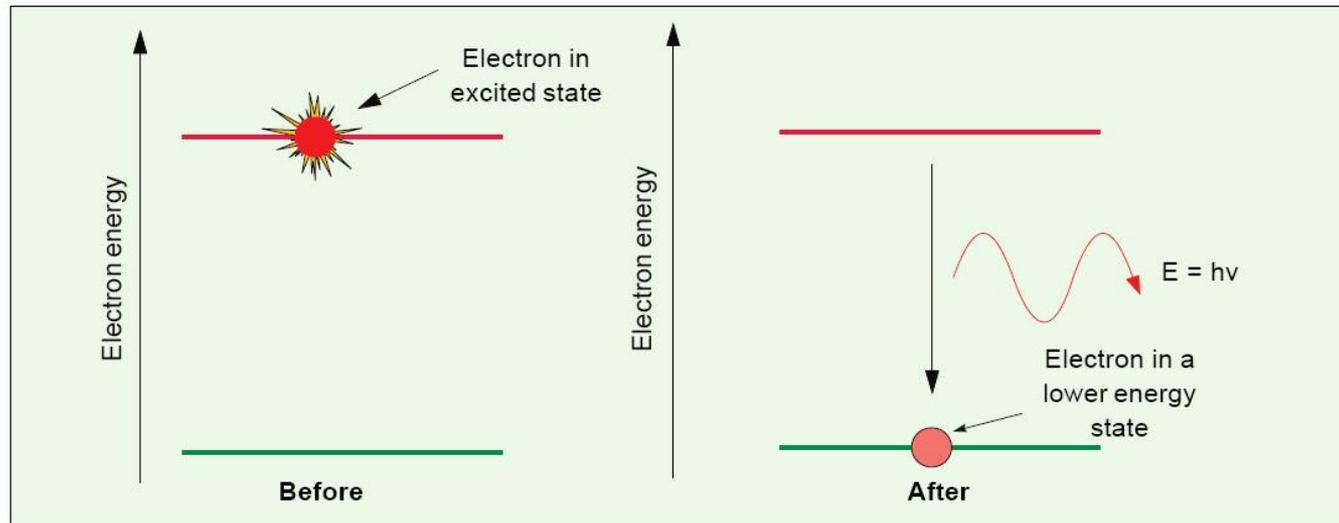


curse of the elephant man
premier episode
sunday 8pm



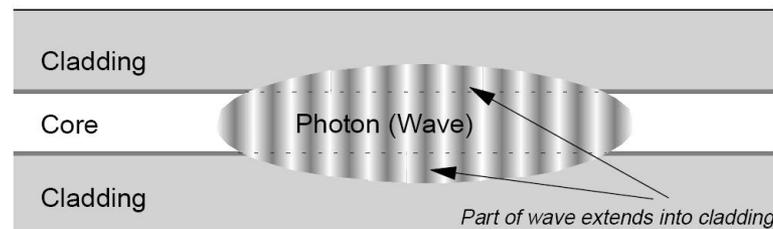
Through the Wormhole S02E07 How Does the Universe Work

Model cuantic – foton



$$E_g = h\nu; \quad \lambda = \frac{hc}{E_g}; \quad \lambda[\mu\text{m}] = \frac{1.240}{E_g[\text{eV}]}$$

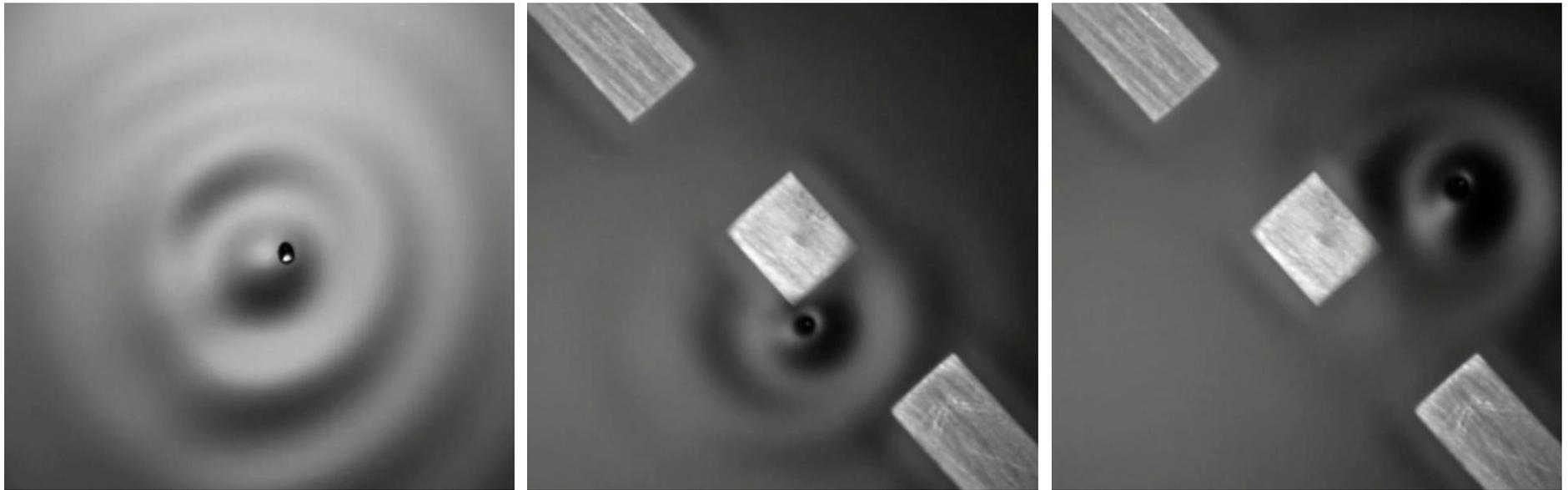
- ▶ h constanta lui Plank
 $6.62 \cdot 10^{-32} \text{ Ws}^2$
- ▶ c viteza luminii **in vid**
 $2.998 \cdot 10^8 \text{ m/s}$



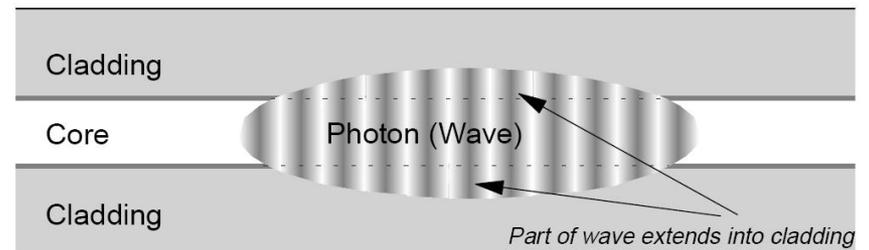


Through the Wormhole
S02E07 How Does the Universe Work

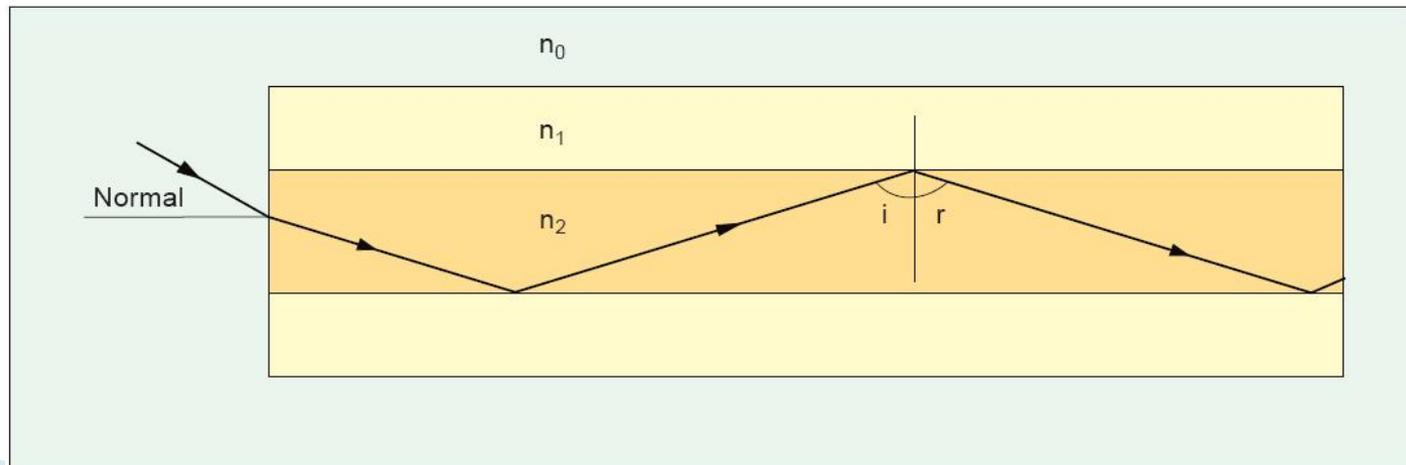
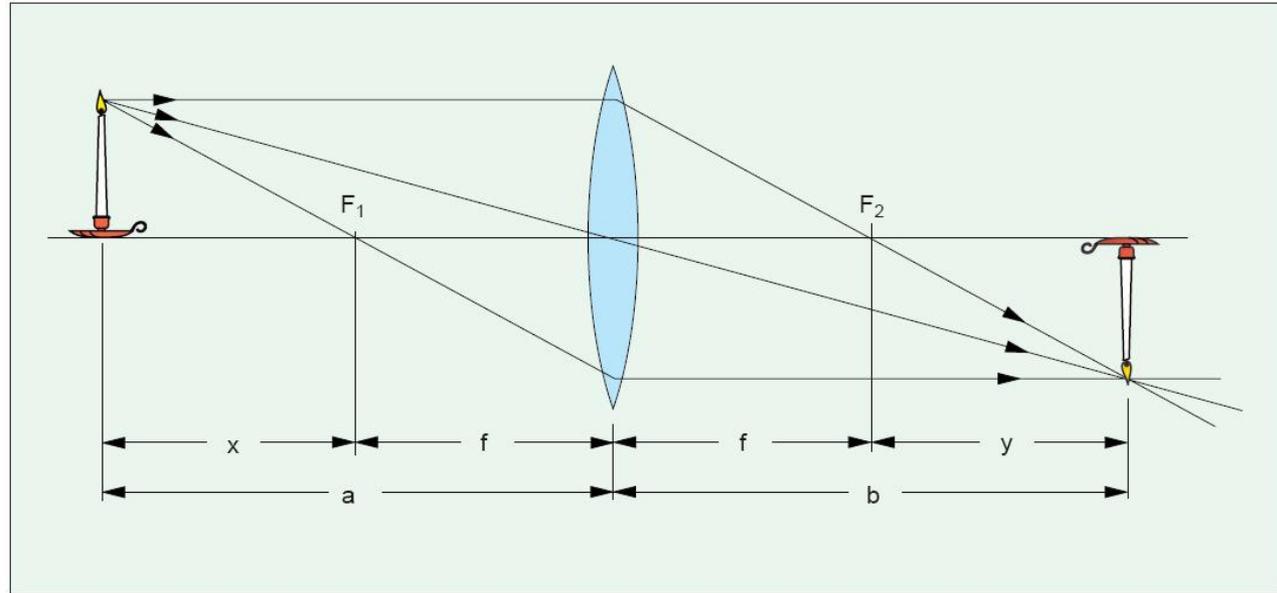
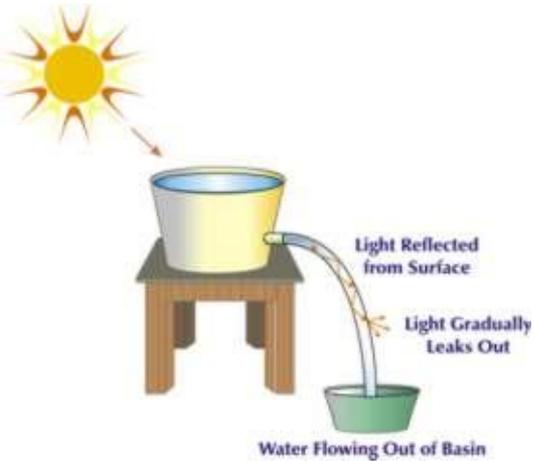
Modelare



Through the Wormhole
S02E07 How Does the Universe Work



Optica geometrica



Contact

- ▶ Laboratorul de microunde si optoelectronica
- ▶ <http://rf-opto.etti.tuiasi.ro>
- ▶ rdamian@etti.tuiasi.ro