

# Optoelectronică, structuri și tehnologii

Curs 9  
2013/2014

# Orar

- ▶ Examen
  - 10.12.2013, P7

# Zgomotul traductorilor electro-optici

Capitolul 10



# Zgomotul emitatorilor optici

## ▶ LED

- este considerat o sursa lipsita de zgomot
- nu contamineaza semnalul cu zgomot suplimentar

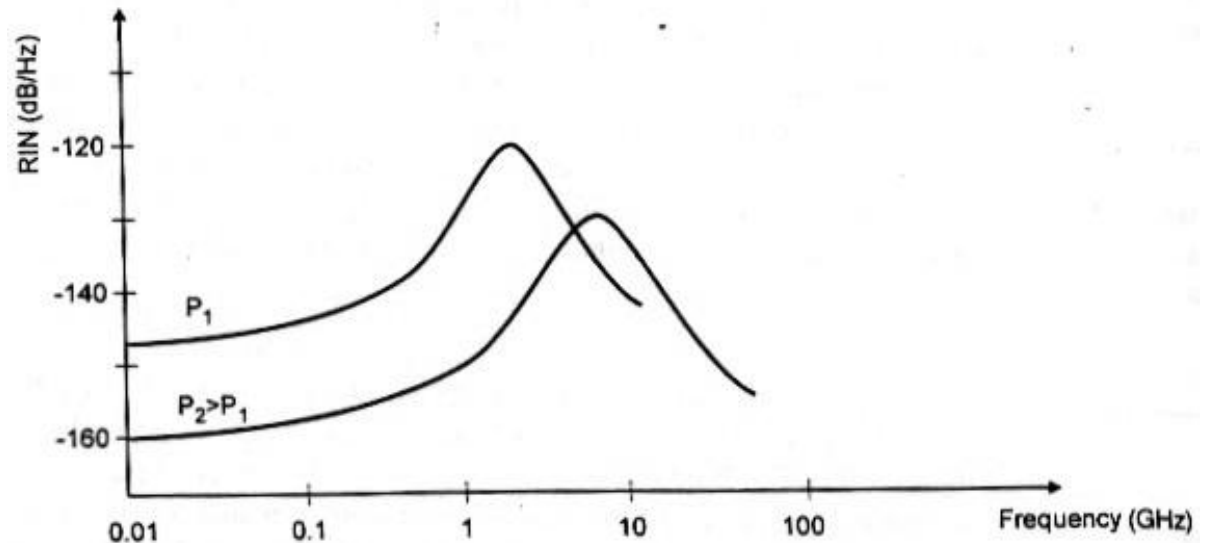
## ▶ Dioda LASER

- fluctuatii de faza, determina o largire a spectrului emis
- fluctuatii de intensitate, determina zgomotul de intensitate introdus de dioda
- RIN – Relative Intensity Noise

$$RIN[1/Hz] = \frac{\langle P_n^2 \rangle}{\langle P^2 \rangle \cdot BW}$$

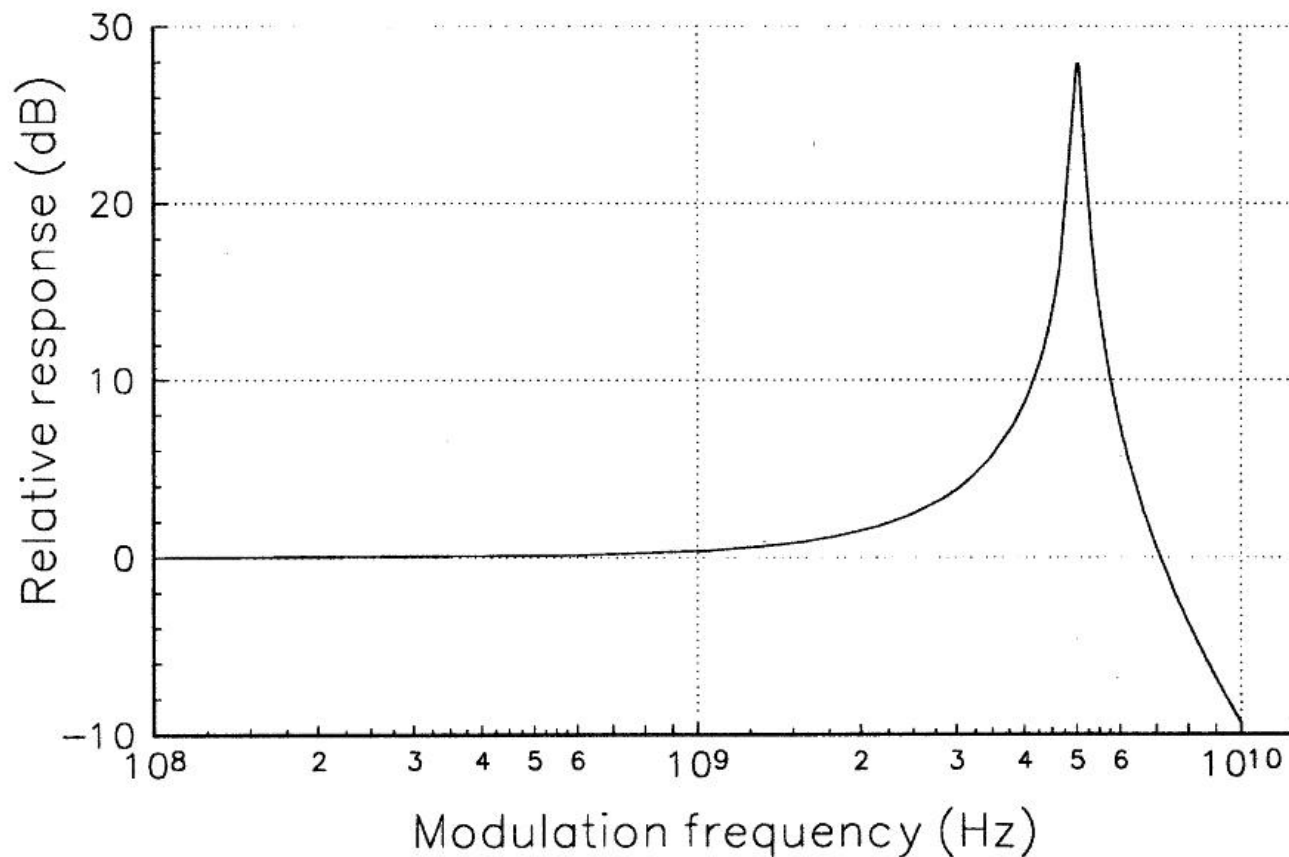
# RIN

- ▶ reprezinta o densitate spectrala de zgomot
  - puterea de zgomot depinde de RIN si de banda semnalului
- ▶ Depinde de puterea semnalului
  - $P^{-3}$  la puteri mici,  $P^{-1}$  la puteri mari



# Raspunsul unei diode laser

- ▶ oscilatii de relaxare - x GHz



# EIN

## ▶ Equivalent Input Noise

- $R_i$  – rezistenta de intrare in circuitul de modulare a diodei
- Variatiile de putere (zgomot) echivalente unor variatii de curent (zgomot) prin dioda

$$\langle P_n^2 \rangle = r \cdot \langle I_n^2 \rangle$$

$$EIN[W] = R_i \cdot \langle I_n^2 \rangle \quad 1 \text{ Hz banda}$$

$$EIN[W / Hz] = RIN \cdot (I_0 - I_{th})^2 \cdot R_i$$

# Zgomotul fotodiodei

## ▶ NEP

- Noise Equivalent Power
- $r$  – rezonvizitatea diodei

$$NEP[W] = \frac{\int \sqrt{\langle i_n^2 \rangle} df}{r}$$

- $r$  depinde de  $\lambda$ , implica NEP depinde de  $\lambda$
- In cataloage apare de obicei densitatea spectrala

$$NEP[W / \sqrt{Hz}] = \frac{\sqrt{\langle i_n^2 \rangle}}{r} = \frac{NEP}{\sqrt{BW_{PD}}}$$



# Zgomotul fotodiodei

## ▶ NEP

- cea mai mica putere detectabila

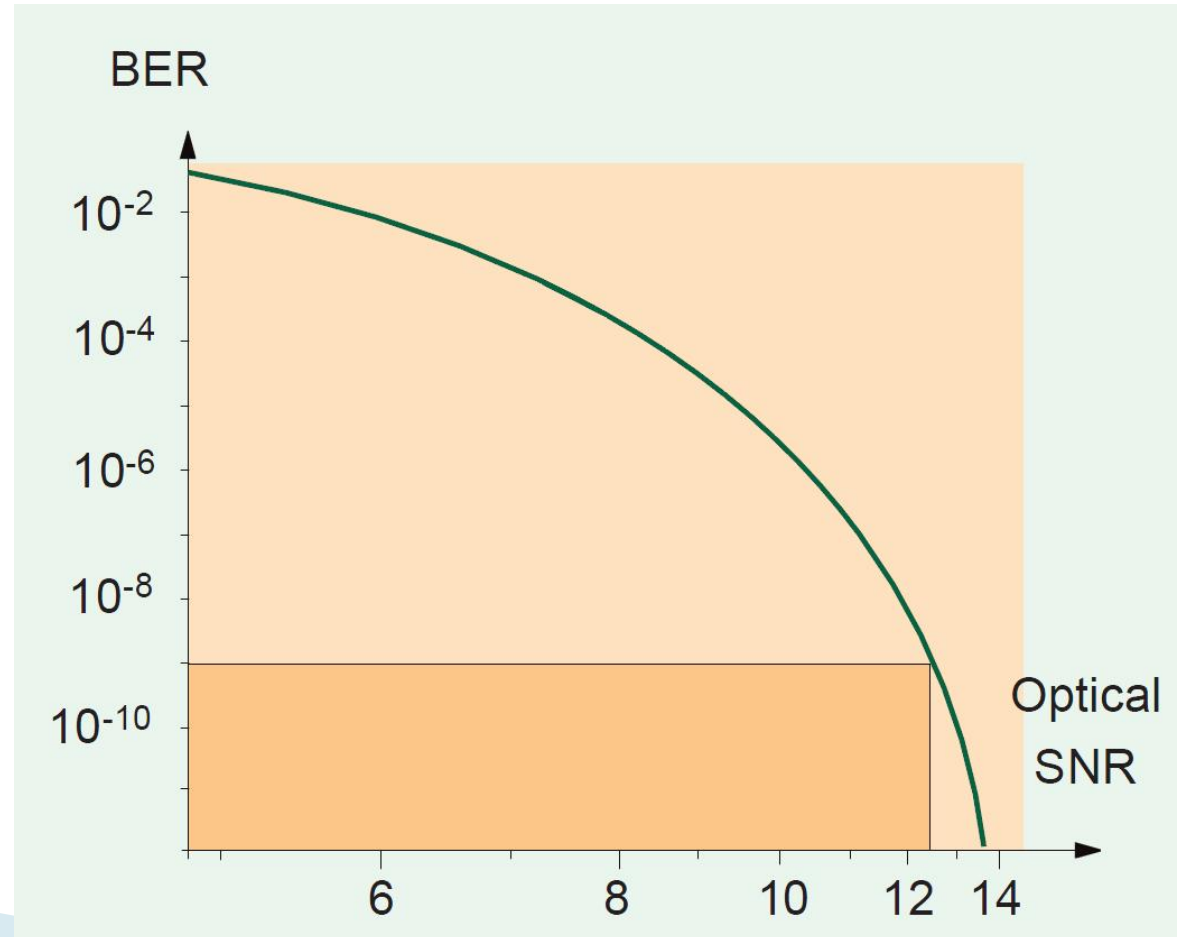
$$\langle i_n^2 \rangle = 2 \cdot e \cdot I \cdot BW_{PD} = 2 \cdot e \cdot (I_S + I_{dark}) \cdot BW_{PD}$$

$$P_{\min} = \frac{\sqrt{\langle i_n^2 \rangle_{\min}}}{r} = \frac{1}{r} \cdot \sqrt{2 \cdot e \cdot I_{dark} \cdot BW_{PD}}$$

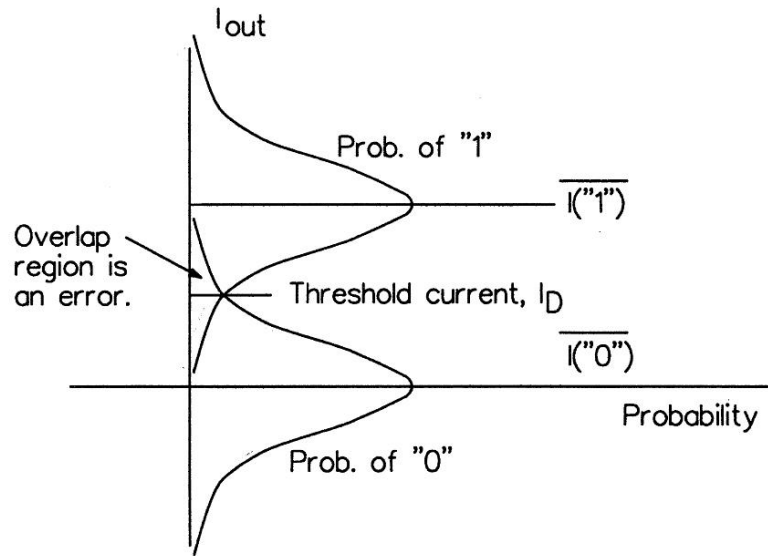
$$NEP[W / \sqrt{Hz}] = \frac{1}{r} \cdot \sqrt{2 \cdot e \cdot I_{dark}}$$

# BER

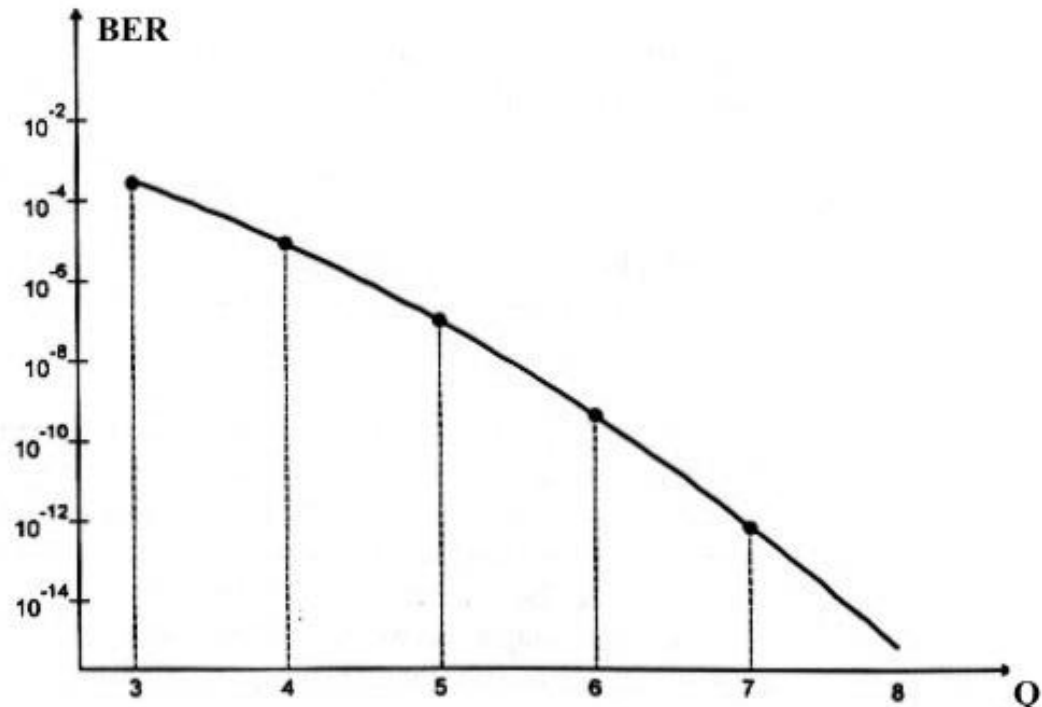
## ▶ Bit Error Rate



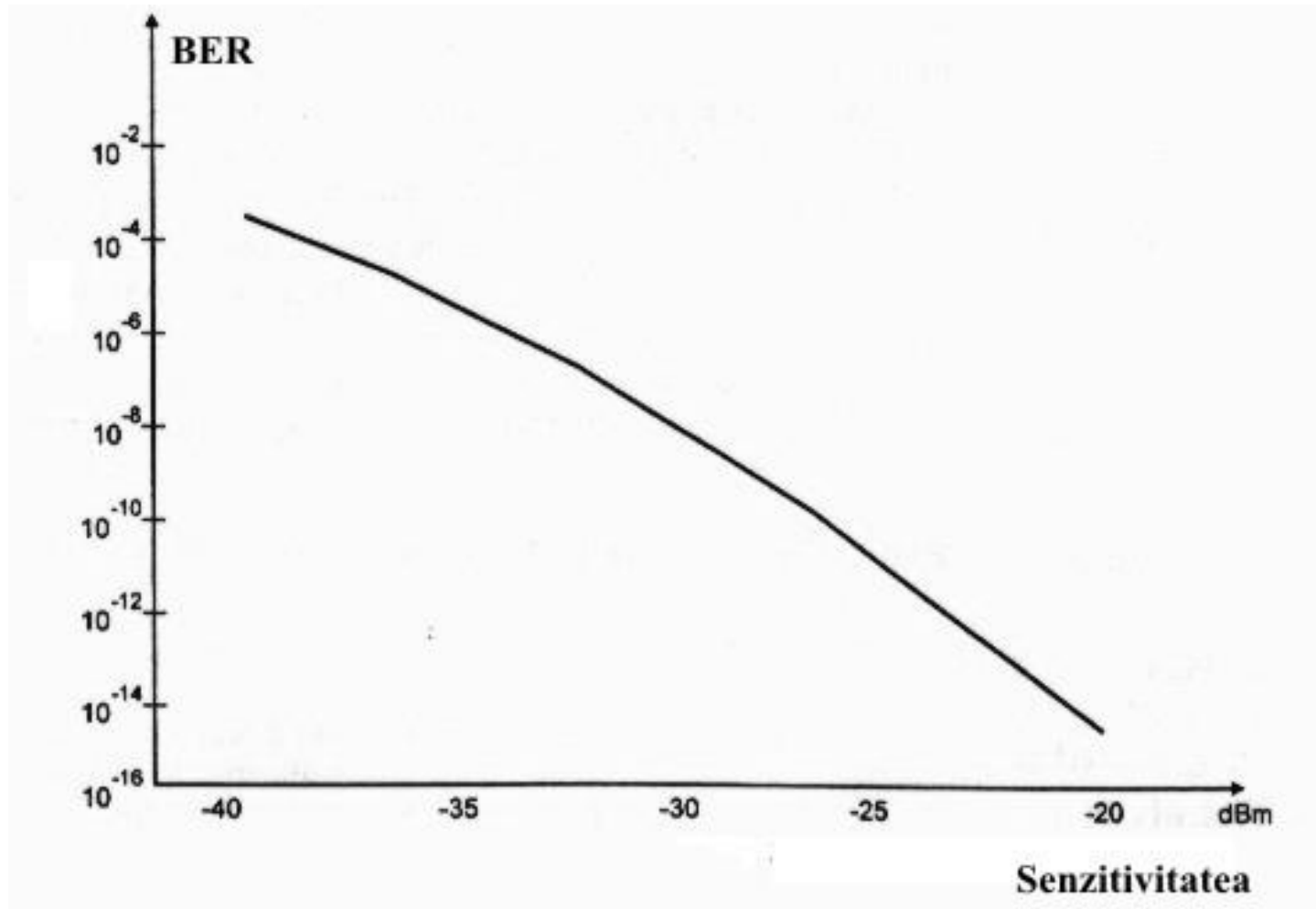
# Probabilitate de eroare



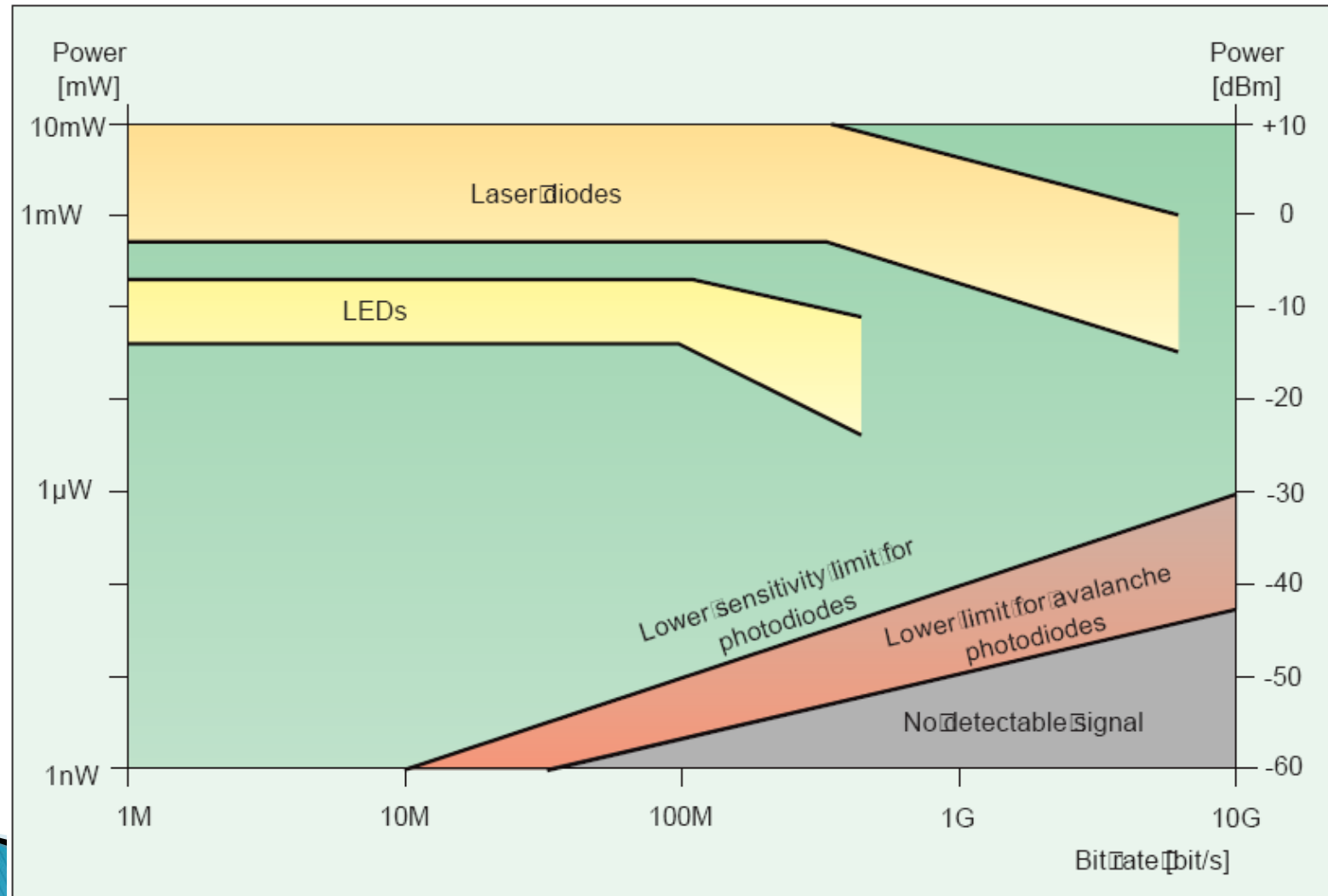
$$Q = \frac{\overline{i("1")} - I_D}{\sigma_1} = \frac{I_D - \overline{i("0")}}{\sigma_0}$$



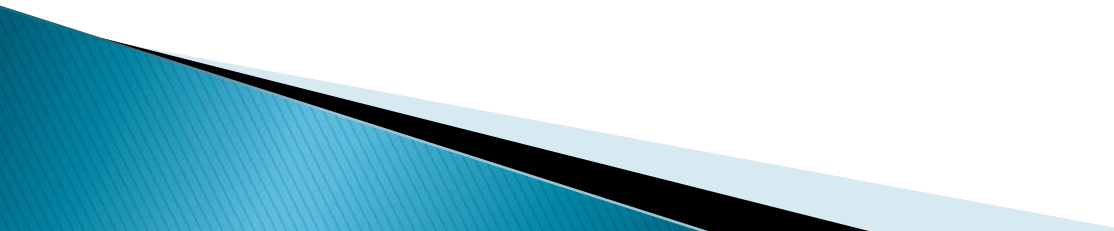
# Senzitivitatea unei diode



# Limite putere/bandă a dispozitivelor optoelectronice



# Capitolul 11

- ▶ **Behzad Razavi**  
Design of Integrated Circuits for Optical Communications
  - ▶ carte1.pdf (2,3)
  - ▶ 29 pg.
- 

# Lista subiecte

- ▶ Amplificatoare transimpedanță
  - 4.1
  - 4.1.1
  - 4.2
  - 4.2.1
  - 4.3
  - 4.3.1
- ▶ Circuite pentru controlul emițătoarelor optice
  - 10.3
  - 10.3.1
  - 10.4
  - 10.4.1

# Contact

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