# Semiconductor laser rate equations

$$\frac{d\Phi}{dt} = Cn\Phi + R_{sp} - \frac{\Phi}{\tau_{ph}}$$

Photon rate =stimulated emission+spontaneous emission+photon loss

[4-25]

$$\frac{dn}{dt} = \frac{J}{qd} - \frac{n}{\tau_{sp}} - Cn\Phi$$

electron rate = injection + spontaneous recombination + stimulated emission

C: Coefficien t expressing the intensity of the optical emission & absorption process

 $R_{
m sp}$ :rate of spontaneous emission into the lasing mode

 $\tau_{ph}$  : photon life time

J : Injection current density

# **Rate Equations In Semiconductor Electronics**

**John Edward Carroll** 

#### **Rate Equations In Semiconductor Electronics:**

Rate Equations in Semiconductor Electronics John E. Carroll, J. E. Carroll, 1990-03-30 This book presents a novel approach to the teaching of dynamic aspects of the operation of semiconductor and opto electronic devices Such dynamic aspects often determine the steady state conditions Also the dynamical operation of such devices is of increasing importance as modern methods of communicating data and information require electronic devices that switch electrical or optical signals at ever faster rates The author discusses the rates at which electrons and holes can reach equilibrium the rates at which transistors and diodes can switch and the rates at which electrons and holes can interact with photons and with protons He also applies the rate equations in a unified way to models of light emitting diodes injection lasers and photodiodes Finally the author discusses more advanced topics on the photon statistics of injection lasers mode locking and the application of rate equations and Maxwell s equations to opto electronic devices Transport of Information-Carriers in Semiconductors and Nanodevices El-Saba, Muhammad, 2017-03-31 Rapid developments in technology have led to enhanced electronic systems and applications When utilized correctly these can have significant impacts on communication and computer systems Transport of Information Carriers in Semiconductors and Nanodevices is an innovative source of academic material on transport modelling in semiconductor material and nanoscale devices Including a range of perspectives on relevant topics such as charge carriers semiclassical transport theory and organic semiconductors this is an ideal publication for engineers researchers academics professionals and practitioners interested in emerging developments on transport equations that Rate Equations in Semiconductors Electronics John Edward Carroll, 1985 govern information carriers **Ouantum Processes in Polar Semiconductors and Insulators** Harald Stumpf,2013-03-09 **Optoelectronic Integrated Circuit Design and Device Modeling** Jianjun Gao, 2011-09-19 In Optoelectronic Integrated Circuit Design and Device Modeling Professor Jianjun Gao introduces the fundamentals and modeling techniques of optoelectronic devices used in high speed optical transmission systems Gao covers electronic circuit elements such as FET HBT MOSFET as well as design techniques for advanced optical transmitter and receiver front end circuits The book includes an overview of optical communication systems and computer aided optoelectronic IC design before going over the basic concept of laser diodes This is followed by modeling and parameter extraction techniques of lasers and photodiodes Gao covers high speed electronic semiconductor devices optical transmitter design and optical receiver design in the final three chapters Addresses a gap within the rapidly growing area of transmitter and receiver modeling in OEICs Explains diode physics before device modeling helping readers understand their equivalent circuit models Provides comprehensive explanations for E O and O E conversions done with laser and photodiodes Covers an extensive range of devices for high speed applications Accessible for students new to microwaves Presentation slides available for instructor use This book is primarily aimed at practicing engineers researchers and post graduates in the areas of RF microwaves IC design photonics and lasers and solid state devices The book is also a strong

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Physics Briefs ,1993 European Quantum Electronics Conference ,2003 Computational Electronics

Technical Report ,1991 Physical Models for Semiconductor Devices John E. Carroll,1974

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