Course

Quantum Sources of Radiation (QCL)

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The purpose of the lecture is to show how quantum mechanics has helped to construct intensive coherent sources of electromagnetic radiation. Elements of quantum mechanics, electrodynamics and statistical physics important for functioning of different types of light amplifiers, knows as lasers, will be presented. The course will cover fundamentals of lasers, design methods and operation, new laser structures with improved optical and thermal behavior, technological problems and possible applications. Emphasis on solid state light emitting diodes and its recent revolutionary developments, like quantum cascade lasers, will be placed. The role of quantum wells and superlattices will be described. The course is closely related to the activities of the Regional Epitaxy Laboratory for Nanostructures created recently by the Faculty of Physics, Warsaw University of Technology and the Institute of Electron Technology in Warsaw.

Scope:

BASIC

1. Introduction
2. Fundamentals of quantum mechanics
3. Principles of design and operation
4. Particular laser structures
5. History of different concepts

MODELLING

6. General principles
7. Quantum treatment of charge carrier transport
8. Various approaches
9. Non-equilibrium Green function method

TECHNOLOGY

10. Challenging technological problems
11. Possible innovative applications
12. Costs and advantages
13. Research program for quantum cascade lasers

Literature

C.H. Townes, *How the laser Happened: Adventures of a Scientist*, Oxford University Press, Oxford (1999).

A. Tredicucci, C. Gmachl, F. Capasso, A.L.Hutchinson, D.L. Sivco and A.Y. Cho, *Appl. Phys. Lett.* **76** (2000) 2164–2166.