NTNU

Innovation and Creativity

This is it: Undergraduate and graduate course on

QUANTUM OPTICS

TFY 4292/FY8300 (Autumn 2019)

Physical and practical applications of quantum optics will be the main ingredient in this course. Heavy formalism will be avoided as far as possible. If desired, students may be offered an option of assigned projects during the course. For graduate students these projects may be in accordance with their research interests.

The content of the course will be :

- *ABC of Quantum Mechanics, Composite Quantum Systems, and EPR.*
- *The Quantum Theory of Radiation, Decay Processes, and the Lamb Shift.*
- *Coherent States and Squeezing of Quantum States.*
- *The Quantum Theory of Coherence and Photon-Photon Interferometry.*
- *Cavity Quantum Electrodynamics and Atom Chips.*
- *Non-Linear Quantum Optics - Parametric Down & Up Conversion.*
- *Master Equations – Open Systems and the Quantum Theory of Damping.*
- *The Process of Decoherence and Macroscopic Quantum Effects.*
- *Photonics and the Quantum Human Eye - From Photons to Neurons.*
- *Recent Results in Quantum Optics on Cloning in Quantum Mechanics, Quantum Cryptography, Quantum Computers, and Quantum Technology.*

The course will be lectured *5-6 hours a week* during one semester including one to two hours for exercises. The home-exam will be *written* and it is expected that the participants solve a set of *obligatory problems* given during the course.

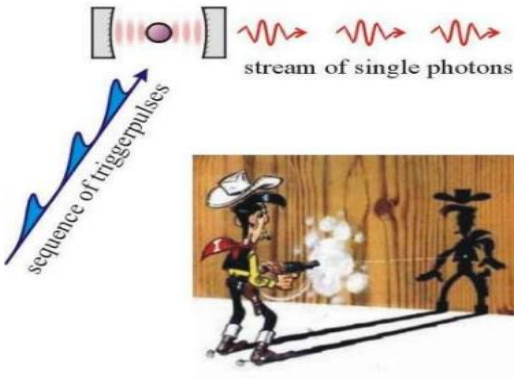
Recommended literature:

Lectures notes (" *Introductory Notes on Quantum Optics and Physical Applications – 2019* " by B.-S. Skagerstam) and selected articles, which covers the complete course, will be provided. Students are also recommended to make use of C. C. Gerry and P. L. Knight, " *Introductory Quantum Optics* " (Cambridge University Press, 2005). We also recommend M. O. Scully and M. S. Zubairy, " *Quantum Optics* " (Cambridge University Press, 1997) and L. Mandel and E. Wolf, " *Optical Coherence and Quantum Optics* " (Cambridge University Press, 1995) as references. A detailed and beautiful account on the quantum optics of vision is P. Nelson, " *From Photon To Neuron: Light, Imaging, Vision* " (Princeton University Press, 2017) which we also will refer to.

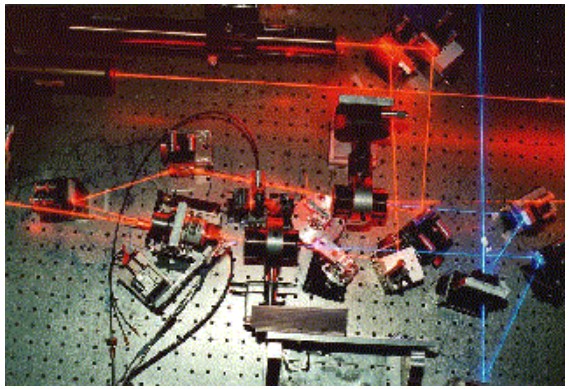
Interested participants can contact Professor Bo-Sture Skagerstam for more information (email: bo-sture.skagerstam@ntnu.no) .

The lectures starts Thursday August 22 at 08:15-10:00 in room RFB E4-107, at 12.15-14.00 in room RFB E4-107, and on Friday August 23 at 10.15-12:00 in room RFB E4-107.

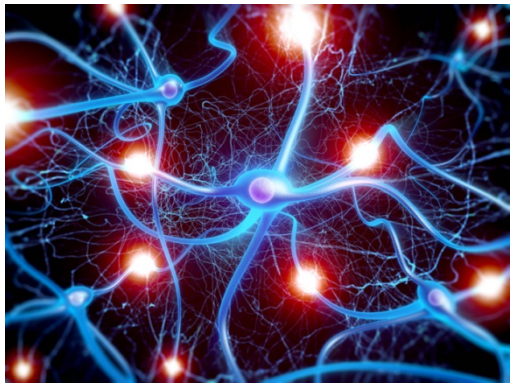
Additional time for questions on course-related issues and problems etc. for all attended students will generously be provided.



A photon gun can be made in real life!



Photon correlation experiments in reality.



Light beams of photons mimics biological neuron networks!