The Abstract of MSc Thesis:

Generation of Non–classical Light from Quantum Dots

When a semiconductor material is used as the active medium to generate photons, for example in semiconductor laser and LED's, the carrier current (electrons and holes) is converted in to a photon current. Depends on how much conversion can be fast and efficient, statistical property of carriers ("pump noise") are transferred to photons, so that if we suppress noise of carrier to below the shot noise value, the noise of output photons can also be suppressed below the Poisson limit.

In the mesoscopic limit, we can use ultra small semiconductor tunnel junction, and because of correlation between successive electrons tunneling in it, we can suppress noise of the carrier current. In this regime single-electron charging energy (e^2/C, where C is a capacitance associated with the tunnel junction) is larger than the thermal energy (K_BT), so that it can induce large correlation successive electron injection event. More specifically, electron injection through the barrier by tunneling or across the barrier by thermionic emission can be strongly inhibited by an earlier injection event provided that circuit recovery time is long compared to the tunneling time .The first theoretical prediction and experimental demonstration of this effect were reported in the late 1980 and became widely known as the coulomb blockade effect.

Simultaneous coulomb blockade effects for electrons and holes can exist in a mesoscopics p-n junction, and non-classical light can be generated from such a structure.

In this thesis I have studied a single-photon turnstile device (theoretical and review the experimental result), where a single electron and a single hole are injected into the optically active region of a p-n junction to generate a stream of regulated single photons.

I also have studied new light sources based on single Quantum dots to generate regulated single photons and entangled photon-pairs.

Principal Reference:

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4. **"Semiconductor Devices"** by S. M. Sze; John Wiley and Sons, 1985.
5. **"Introduction to Semiconductor Optics"** by N. Peyghambarian, S. W. Koch and A. Mysyrowicz; Printice Hall, 1993.
6. **"Theory of Non-classical States of Light"** by V. V. Dodonov and V. I. Man'ko; Taylor & Francis, 2003.
7. **"Quantum Theory of the Optical and Electronic Properties of Semiconductors"** by H. Haug and S. W. Koch; World Scientific, 1993.