" **Photonic Molecules for Subwavelength Light Confinement: Design and Applications**".

Abstract of my thesis is

"**Similar to the confinement of an electron in a potential well, photons can be spatially confined inside a high index resonator. This confinement can be used to create efficient strong light matter interaction, all optical logic, single photon generation among many other possibilities, provided the resonators possess a small physical volume and low photon decay rate simultaneously. In this thesis, we present two resonator designs, that are 30 times smaller than the wavelength of light in a single direction and exhibit large quality factors. Thereafter, we proceed with three different applications of these resonators.
First application is to slow down the group velocity of light. In the past, many works have been aimed at using a two-resonator model to describe such a system, but fail to provide information about the transmission and group delay. We develop an alternative model that can describe the scattering parameters of such a slow light system with good accuracy. The model also predicts a new phenomenon, namely classical analogue of electromagnetically induced absorption. These predictions are subsequently demonstrated in experiments at GHz and THz frequencies.
In the second application, we use these resonators to create media with properties unattainable in nature, more popularly known as metamaterials. We demonstrate a low-loss metamaterial by exploiting dark bound states in dielectric inclusions coupled to the external waves by small nonresonant antennas. Finally, we experimentally demonstrate a low loss metamaterial that exhibits negative permittivity or permeability, either separately or simultaneously at GHz and THz frequencies.
In the third and final application, we show that the proposed low loss resonators can serve as a route to miniaturization of laser systems. Till date, all approaches encounter a trade-off between the system dimensions and the Q factor, especially when going subwavelength. We propose a laser system that overcomes this trade-off and offers radiation tunability, directionality, subwavelength integration and simple layer-by-layer fabrication.** "