| Popular science summary of the PhD thesis  |
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| PhD student | Piotr Marek Kamiński |
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| Title of the PhD thesis | Active nanophotonic antenna arrays for effective light-matter interactions |
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| PhD school/Department | DTU Electrical Engineering |
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| Science summary |
| \* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology: |
| The research activities have been identified with a motivation to investigate truly novel physical phenomena in photonic crystals for nanolasers applications with potential for new fundamental discoveries and technologies. In the first part, a range of fundamental phenomena and a means of controlling them were investigated in photonic crystals with the overall purpose of improving light confinement in lasing cavities while maintaining their small footprint. 3D photonic crystal configurations of circular or elliptical holes were shown to exhibit a rapidly increased light confinement with the size of the structure, while allowing surface emission of light. Compared to the circular air-holes, the configurations with elliptical air-holes enabled uniform light distribution with no localization effects and have been shown to control mode spacing in the frequency domain by a sheer rotation of the air-hole. The results of this part may be of potential use in optical switches, sensors and particularly in the design of low threshold single mode nanolasers. In the second part, attention was devoted to the self-pulsating Fano laser and comprehensive investigations of its dynamic model. It was shown that the standard and complicated 5D model can be appropriately replaced by a 2D model (and sometimes even a 1D model) after its initial transient stage. The simplicity brought about with the reduced models enables an alternative view of laser dynamics, and determination of previously unknown origin of the laser instability in the parameter region in which the standard stability analysis predicts an otherwise stable operation. The laser instability was classified in detail, and a range of phenomena in self-pulsating lasers were analyzed and explained. The results of this part may offer an interesting route towards new functionalities in nanolasers used e.g., for on-chip communications.  |

Please email the summary to the PhD secretary at the department.