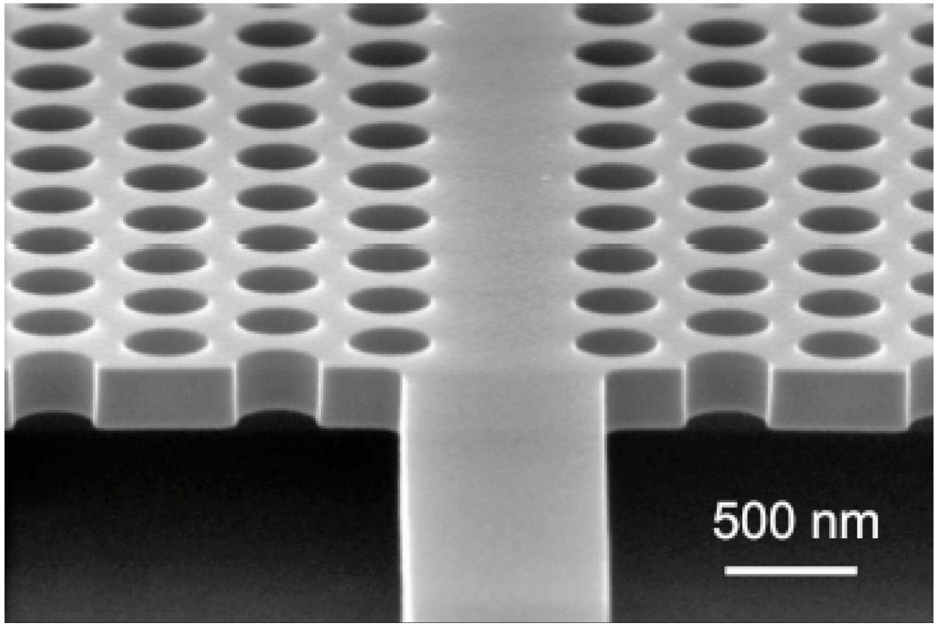
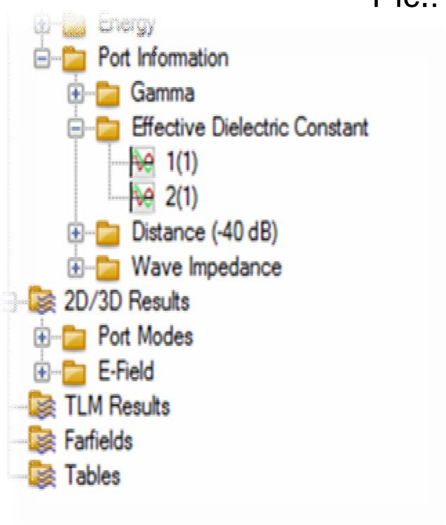
Photonic Crystal Microcavity



Pic.: McNab et. al. Opt.Expr. 11, 2003;



Paper: Tuning the resonance of a photonic crystal microcavity with an AFM probe

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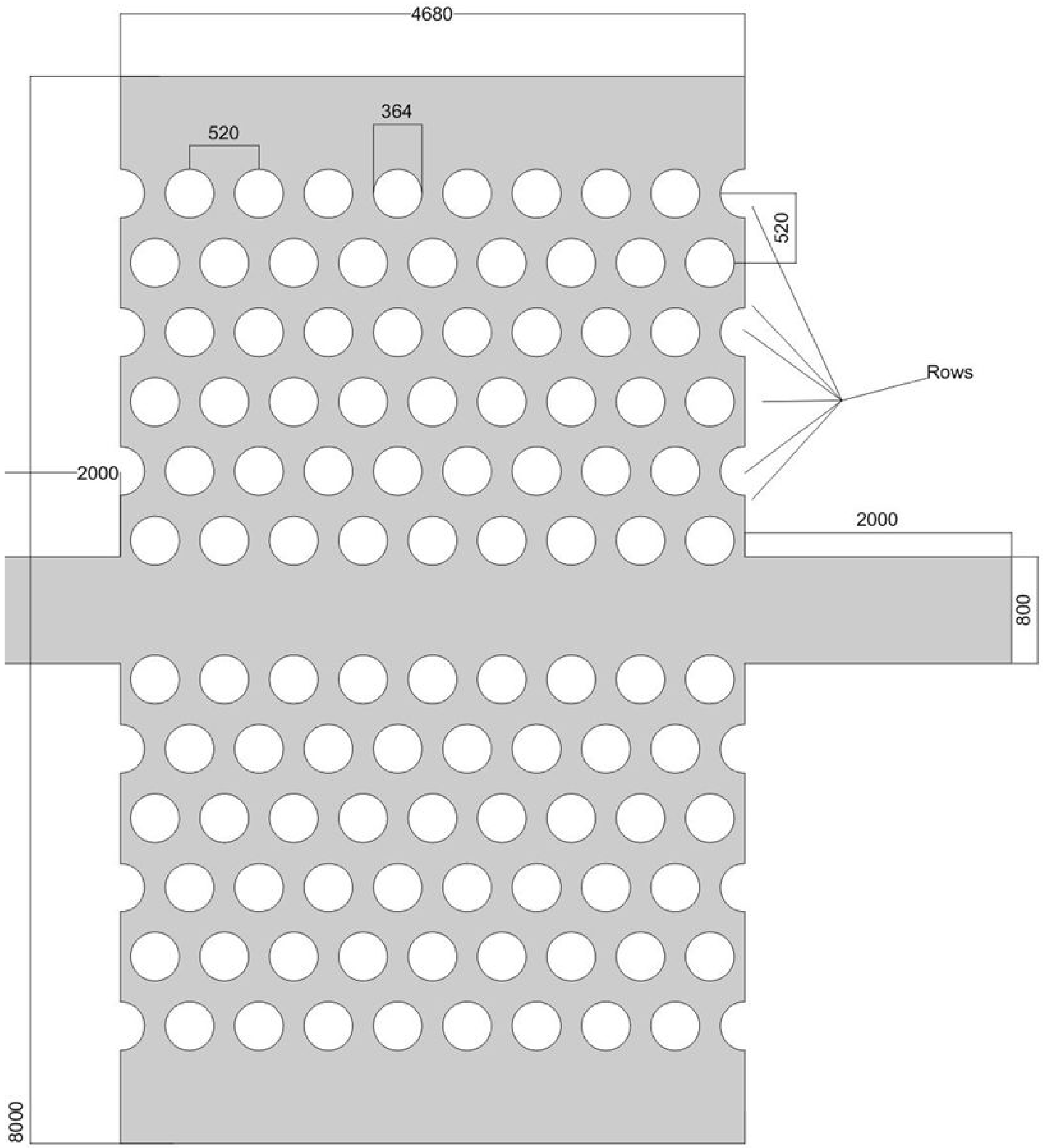
From Wikipedia: “Photonic crystals (PhC) are composed of periodic dielectric, metallo-dielectric or even superconductor micro- or nanostructures that affect the propagation of electromagnetic waves (EM) in the same way as the periodic potential in a semi-conductor crystal affects the electron motion by defining allowed and forbidden electronic energy bands.” By adding „defects“ to the Photonic crystals one can design waveguides and resonators out of a PhC.

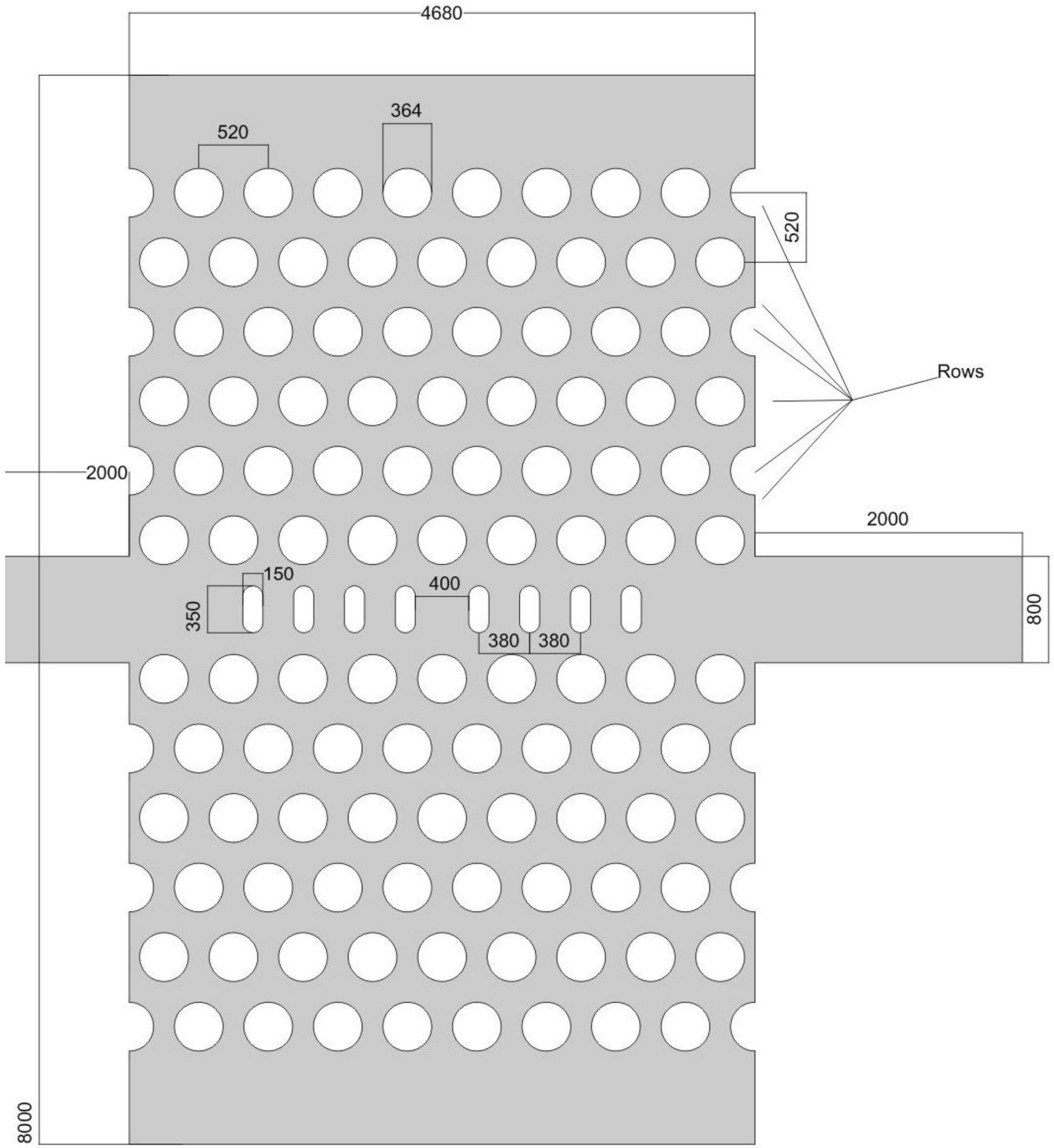
Geometry Details part 1



In this project, you will start with build a PhC waveguide. The EM wave can propagate in the defect area but NOT inside the PhC (Bandgap). The light is confined in the defect area.

PhC of cylindrical holes in a thin Si (Epsilon=12.25) membrane layer:
thickness = 205 nm, hole radius = 182 nm, period = 520 nm

Geometry Details part 2



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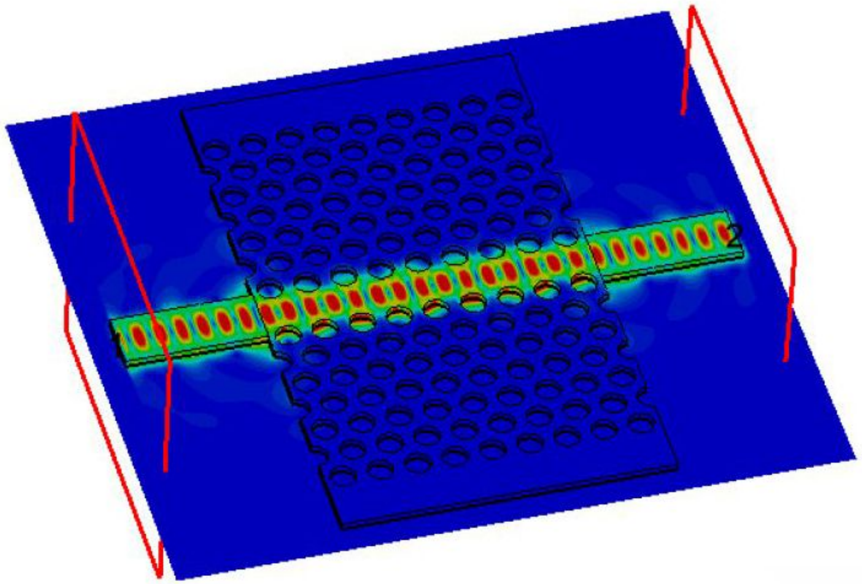
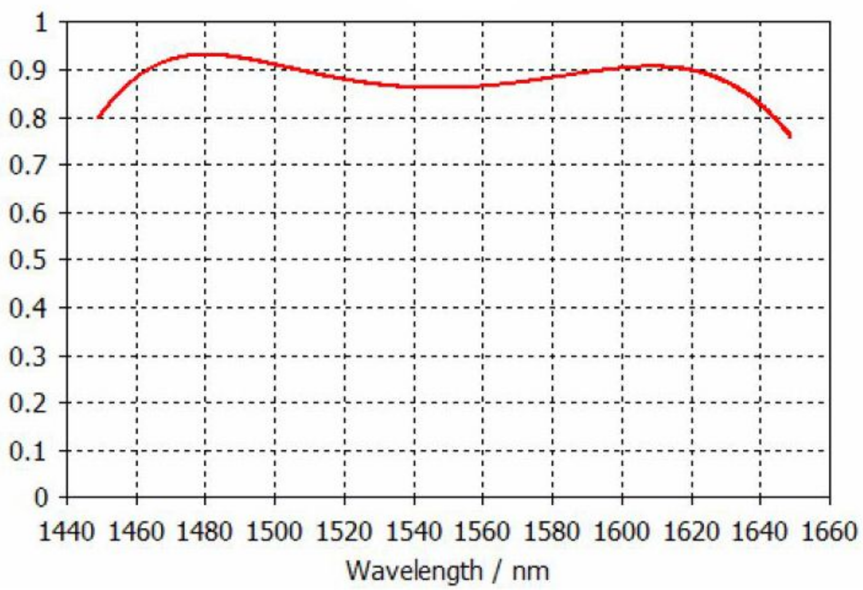
In the next step, a resonator will be added.

The Bragg reflectors embedded in the photonic crystal waveguide and has a length of 400 nm (distance between the two Bragg reflectors). Bragg reflectors:
hole width = 350 nm, hole length = 150 nm, period =380 nm

Simulation





In the first part you have to simulate with CST Microwave Studio the e-field of the waveguide, the wavelength dependence, energy losses…

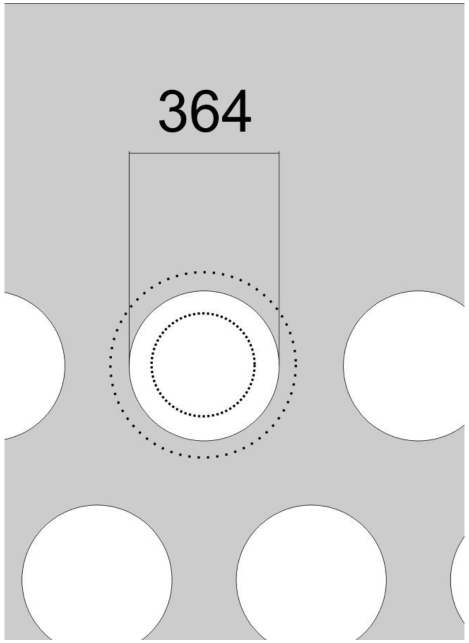
In the second part after you add the Bragg reflectors, you have to show and explain the changes that you can see in your simulation.

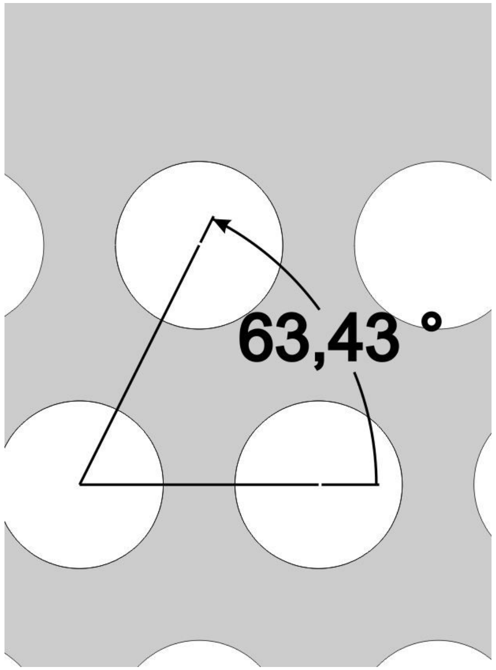
In the last part of your work you have to study the behavior of the variations:

• of the dimensions of resonator gap (200 - 600 nm)

• of the quantity of rows (3, 6, 9) each side simultaneously

Simulation 2





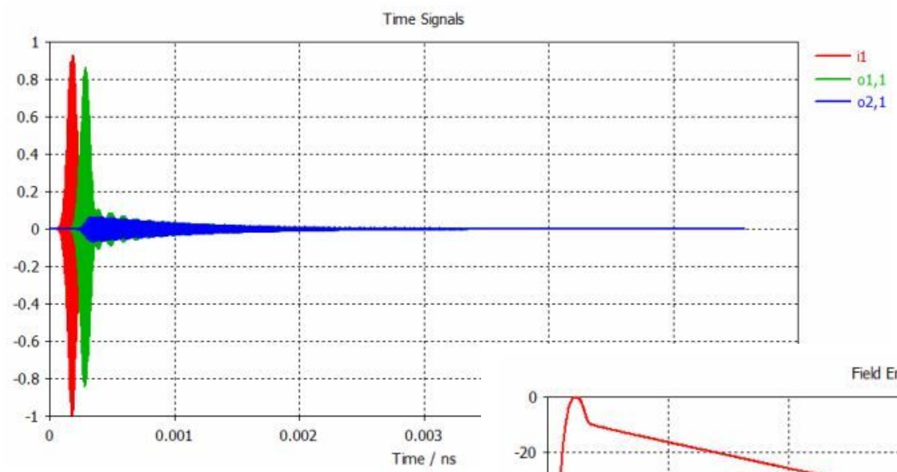
Also you have to study the behavior of the variations:

• of the air-hole radius (250 – 450 nm)

• change the angle between 50° and 75° to go away from compliant hexagonal structure

• to take an convergence investigation of the grid

Results



At the end of your project you have to present your results in one talk in our group and submit an elaboration/documentation of your work.