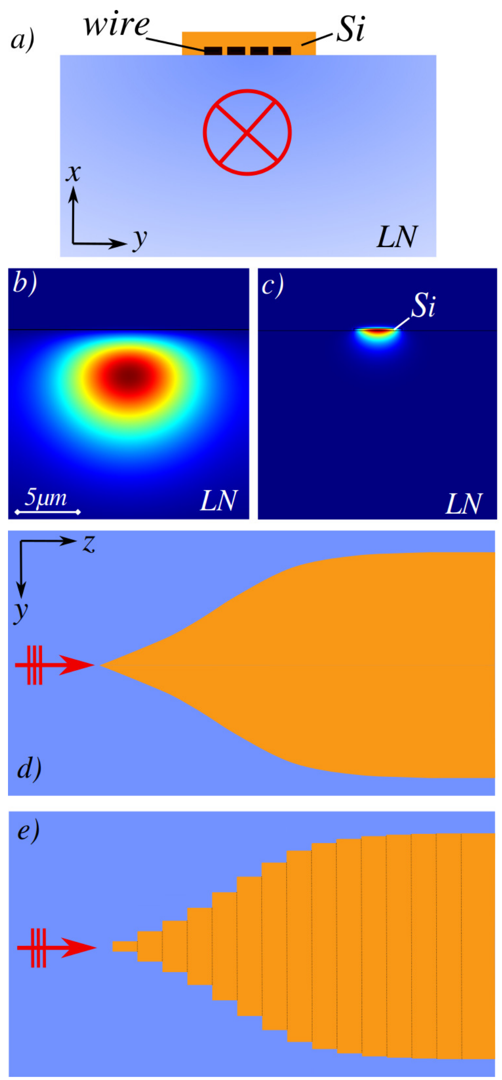
Proposal for a master thesis topic / project topic

Title:
Optimizing taper on lithium niobate waveguides

Description:
Titanium indiffused lithium niobate (LN) waveguides in combination with superconducting nanowires are used as photon detectors [1]. In order to detect as many photons as possible, the guided mode of the waveguide should has its maximal amplitude in the center of the wires, but this is not the case for this structure. Therefore, an additional silicon layer (Abb. a)) is deposited on the waveguide to "pull up" the guided mode into the wires. In order to guarantee a lossless transition of the excited mode in the lithium niobate waveguide (Abb. b)) to the mode in the waveguide with silicon layer (Abb. c)), the silicon layer is tapered (Abb. d)).
The different scales of the waveguide layers and the length of the taper (compared to the wavelength) do not allow an efficient calculation with commercial numerical tools. Therefore, a method based on the expansion of basic solutions is applied here [2]. Using a stepwise approximation of the taper (Abb. e)), the propagation of the wave can be described by calculating mode overlap integrals that determine the power transfer from one cross-section to the next.
In this work, the shape of the taper is to be optimized considering little radiation and a maximal field amplitude in the wires. This ensures maximal power absorption and many photons can be detected. The task is to be implemented using the simulation software Comsol Multiphysics should be used in combination with Java and/or Matlab.



Literature:
[1] J.P. Höpker et al., 'Towards integrated superconducting detectors on lithium niobate waveguides', SPIE Nanoscience + Engineering, 2017.
[2] M. Hammer, 'Optical Waveguide Theory', Lecture: https://www.computational-photonics.eu/theory.html.

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