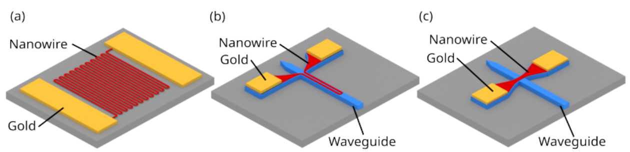



Figure 3.2.: Meander SNSPDs vs. waveguide-integrated SNSPDs. (a) In conventional SNSPDs, a narrow nanowire is typically patterned in a meander shape across a relatively large area. The nanowire is then illuminated with the light incident plane perpendicular to the substrate. Typically, cavity layers are placed around the SNSPD in order to enhance the absorption, as the interaction length between the nanowire and the incoming light field is otherwise limited to the layer thickness of the superconducting material, which is typically in the order of magnitude of a few nanometers. (b) Waveguide-integrated SNSPDs are placed on top of a waveguiding structure and light is coupled to the nanowire only through the evanescent field of the travelling wave. Because the light is travelling through the waveguide along the nanowire, the interaction length can be tuned by changing the length of the nanowire. Overall, much shorter nanowires are sufficient to achieve near-unity absorption as compared to traditional meander SNSPDs. (c) Waveguide-integrated SNSPDs can also be made extremely short, down to a single waveguide crossing. While the efficiency of such short nanowires is typically very low without using enhancing cavities, the recovery time of these nanowires is extremely short, as it is proportional to the overall length of the nanowire.

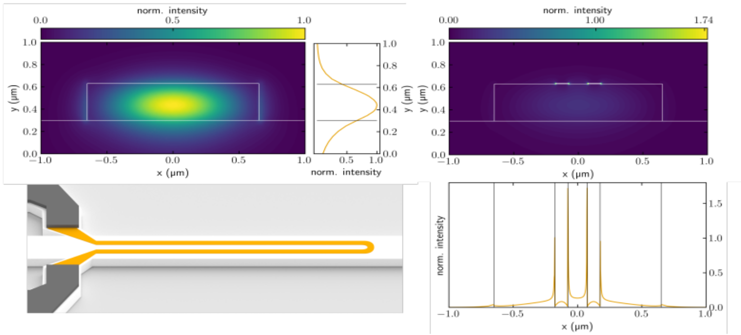
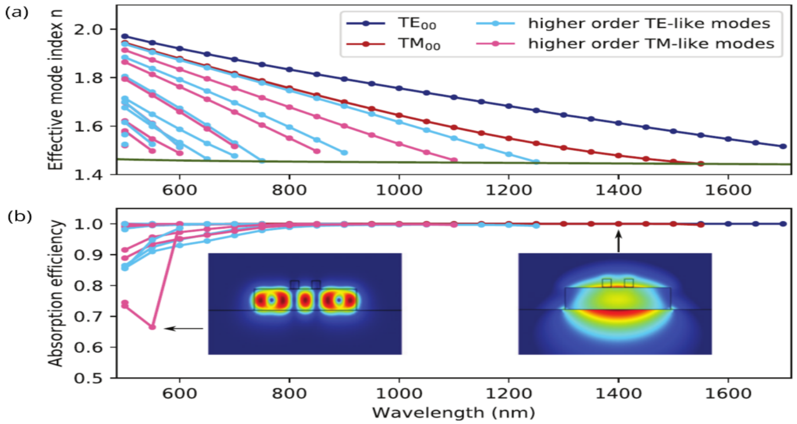



Figure 2.6: Schematics of the operating principle of waveguide-integrated SNSPDs. Left top: normalized intensity of the electromagnetic field inside a silicon nitride waveguide on silicon dioxide substrate. The profile at $x = 0$ shows the exponential decay and a non-zero field intensity outside the waveguide. Right top: intensity distribution in the same waveguide with 4.5 nm thick and 100 nm wide superconducting nanowires on top. Right bottom: intensity distribution at $y = 0.632\,\mu m$, the nanowire center height. A strong field enhancement at the edges of the nanowire is observed. The simulations have been done with COMSOL Multiphysics. Left bottom: schematic of a waveguide-integrated SNSPD in a u-shape geometry. The nanowire (yellow) is fabricated on top of a waveguide (white). The substrate (light grey) and the electrodes (dark grey) for electrical access are also depicted.




e 3.4.: Modes in the WI-SNSPD (a) FEM simulation of the refractive indices of the fundamental TE and TM modes as well as the first higher-order modes in the waveguide with a nanowire on top as a function of wavelength. (b) Absorption efficiency for the modes in the nanowire. It can be seen that even for higher order modes, the simulated absorption remains relatively high. Figure adapted om [129].

To this end, light propagation in polymeric structures is simulated by finite-difference time-domain (FDTD) method using the open-source software package MEEP.