INTERNSHIP PROPOSAL

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Quantum communications at 10 µm wavelength

Protected and secured data transmission is a crucial issue for several economic and social sectors. This spans bank transactions, financial trading and sensitive communications particularly involving remote data centers.
Quantum communication exploits the fundamental laws of quantum physics to protect data.[1] The technologies are based on fascinating concepts like uncertainty principle, quantum measurement and state collapse, entanglement and quantum superposition principle. There are several ways to realize quantum communication, and most of them involve photons at telecom wavelengths that can be transmitted through optical fibers. However, owing to photon loss in optical fibers, the achievable distance using direct transmission is limited to a few hundred kilometers. Free-space optics is thus an interesting approach to go beyond this limit.[2]
The mid-infrared wavelength domain, specifically within 8 µm - 14 µm, holds promise for free-space optics applications. This is primarily due to its atmospheric transparency, reduced aerosol scattering, and resilience in adverse atmospheric conditions, including fog and turbulence. Several demonstrations of free-space communications exist in the mid-infrared,[3,4] all of them are based on classical communication protocols, but none involves quantum concepts.

The objective of this thesis is the realization of systems that assemble unipolar quantum optoelectronic devices (metamaterial photodetectors and phase modulators) with local oscillators to measure quantum states of light in the mid-infrared. This ambitious goal will be achieved by exploiting low-noise and high-sensitivity multiheterodyne detection systems.[5]

References

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