Title:	Entropic quantum contextuality in NV centers and designing microwave antennas
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Keywords:	Entropic quantum contextuality microwave antennas
Issue Date:	Apr-2022
Publisher:	IISER Mohali
Abstract:	This thesis has been carried out in two parts, centered around NV centers in diamonds. The first part was to experimentally demonstrate entropic quantum contextuality in a single NV center in diamond under the guidance of Prof. Dieter Suter at Technical Univer- sity Dortmund. Quantum physics is contextual in nature – the outcome of a measurement depends on whether or not, and how the experiment is performed. Entropic quantum con- textuality arises from the nontrivial conditions imposed by contextuality on the Shannon entropy of the probability distribution of a measurement. We used the results presented by Kurzynski et al. and tried to experimentally demonstrate the non contextual entropic inequality on a qutrit using five state-dependent measurements. We designed a theoretical outline of the whole experiment. The aim was to polarize the electronic levels in the NV center to create a 3-level system, prepare the required states, and measure their population along $\|0\rangle\langle 0\|$. In the latter half, I worked with Dr. Ananth Venkatesan at IISER Mohali to design and fabricate microwave antennas that provide an oscillating magnetic field to the NV centers. Normally, there is a tradeoff between the uniformity and the intensity of the radiation, which warrants the need for new designs. Moreover, most of the antennas produce linearly polarized fields which might be undesirable for certain NV experiments. We designed two microwave antennas with circular polarization, simulated them in CST studio to find the optimum parameters, and fabricated them using optical lithography. The antennas could be further tested on NV centers by taking ODMR and Rabi measurements.
URI:	http://hdl.handle.net/123456789/4177 (http://hdl.handle.net/123456789/4177)
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