Quantum sensor based on nitrogen-vacancy centers in diamond nanopillars for imaging neuronal electrical activity at high spatiotemporal resolution – DiamNeuroSensor

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The propagation of the neuronal electrical signal is well modeled at the millimeter scale by variable conductances. To describe synaptic transmission, which occurs at the micrometer scale, one must add electrodiffusion of charged neurotransmitters into the local electric field E. Comprehensive theory predicts that E depends on synapse shape, which is itself coupled to learning processes in the brain of an organism, but there is no technology to test these predictions by measuring E with the high spatiotemporal resolution necessary for faithful signal recording. We will develop a quantum sensor of neuronal electrical activity in cultured neurons, exploiting the sensitivity to E of the optically detected spin resonance of nitrogen-vacancy (NV) color centers implanted in a dense array of diamond nanopillars. This project combines complementary expertise in nanotechnology (C2N lab), quantum properties of NV centers and neurophysiology (LuMIn lab).