Manipulating the magnetic behavior of charge carriers in a semiconductor quantum dot

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Quantum dots have often been suggested as fundamental building blocks for future quantum technology, as they can be exploited as sources of single photons or hosts of quantum bits. Electrons and holes are confined inside the quantum dots due to the small band gap compared to the surrounding material. These particles not only contain charge, but also spin which can be used to store and process information. To do this, gaining control over the spin of these particles is crucial.

A straightforward way to do this would be to place the dots in a magnetic field and change the direction of this field. However, it is difficult to gain control of the magnetic field on a quantum dot scale and this is therefore not a very viable method. The alternative approach is to control the interaction of the carrier with the magnetic field instead, which is governed by a quantity called the g-factor. The g-factor has been shown to depend greatly on the exact size, shape and composition of the quantum dot. However, none of these parameters can be modified once the dot is grown.

To gain in-situ control of the g-factor, strain can be used. This project has two possible approaches. In the first, the dots are mounted on top of a piezo-electric actuator which can compress the sample in-plane. This has already been shown to work, but there is much room for improvement. In the second approach, nanowire quantum dots can be mounted on top of a so-called microelectromechanical structure (MEMS, see image) which can pull on the wire, generating strain values up to 5%. Simulations show changes in the g-factor up to 400%, but this

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