Magnetic Resonance Force Microscopy and the spin bath : towards single-spin massive-resonator entanglement and the spoiling influence of the spin bath

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Stellingen

Behorend bij het proefschrift
"Magnetic Resonance Force Microscopy and the Spin Bath;
towards single-spin massive-resonator entanglement
and the spoiling influence of the spin bath"

1. When doing Magnetic Resonance Force Microscopy (MRFM) using the magnet-on-cantilever geometry, it is useless to maximize a commercial cantilever's quality factor, unless the surface of the sample is made sufficiently free of electron spins just before cooling down the experiment.
   Chapters 2-4 of this thesis.

2. It is becoming feasible to study the existence of gravitational-induced collapse of the wave function by using a setup where an MRFM-tip interacts with a single Nitrogen-Vacancy center (NV^-) in diamond.
   Chapters 4-5 of this thesis.

3. Now that bonding wires of lead alloys are difficult to obtain, using annealed Nb wire is a possible alternative for creating wire bonds that are superconducting at 4K.
   Chapter 6 of this thesis.

4. It is possible to continuously apply milliamps of RF-currents through a micrometer-wide line on the sample, while keeping the RF-line superconducting, the temperature of the sample below 100mK, and a SQUID magnetometer, which is next to the RF-line, stable.
   Chapters 4 and 6 of this thesis.

5. The dissipation of resonators as function of temperature has been incorrectly fitted by power laws or hyperbolic tangents.
   *M. Imboden and P. Mohanty, "Evidence of universality in the dynamical response of micromechanical diamond resonators at millikelvin temperatures", Physical Review B, **79**, 125424, (2009).*
   *A. Venkatesan, et al., "Dissipation due to tunneling two-level systems in gold nanomechanical resonators", Physical Review B, **81**, 073410, (2010).*
   *A. Bruno, et al., "Reducing intrinsic loss in superconducting resonators by surface treatment and deep etching of silicon substrates" Applied Physics Letters, **106**, 182601, (2015).*

6. The low dissipation of recently developed ladder-shaped cantilevers is only useful for MRFM with micron-sized spherical magnets, if the surface of the sample is completely free of two-level fluctuators.
   M. Héritier, et al., "Nanoladder cantilevers made from diamond and silicon", arXiv:1711.11358, (2017).

7. Equipping measurement setups with 'clean grounds' is a form of technological quackery.

8. For most SPM applications that utilize conductive tips, the complicated dihedral approximation for the calculation of the tip-sample capacitance used by Hudlet et al. will not yield better results than the simple ball-and-plane model of Kleinknecht et al.
   S. Hudlet, et al., "Evaluation of the capacitive force between an atomic force microscopy tip and a metallic surface", The European Physical Journal B - Condensed Matter and Complex Systems, ***2****, 5–10, (1998).*
   H. P. Kleinknecht, et al., "An experimental scanning capacitance Scanning Microscopy", ***2****, 1839–1844, (1988).*

9. Expressing the unit of magnetic field gradient in MT/m is misleading and confusing and T/µm or mT/nm should be used instead.

10. The simplest way to make yourself an infamous physicist is to openly worry about the measurement problem before you are famous.

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