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## Development and testing of the gravitational wave antenna MiniGRAIL in its full-featured configuration

Usenko, O.

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**Author:** Usenko, Oleksandr

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# Stellingen

behorende bij het proefschrift

Development and testing of the gravitational wave antenna  
MiniGRAIL in its full-featured configuration.

- Since a spherical detector is quite compact, compared to other types of detectors, it is possible to fit it in a conventional type of cryostat. As a consequence such a detector is relatively cheap and can be built and operated in a typical research laboratory by a small scientific group.

*This thesis, Chapter 1.*

- For the power typically dissipated by a SQUID ( $\approx 500\text{ pW}$ ), the thermalizing effect of thin film cooling fins has proven to be negligible. A possible solution is a volume shunt resistor, either bulk or implanted into silicon.

*This thesis, Chapter 3.*

- By combining MRI-AFM with SQUID detection, we aim for the ultimate MRI resolution improvement: detection of a single nuclear spin.

*This thesis, Chapter 5.*

- The sensitivity of the nanomechanical resonators, used for MRFM experiments is limited by their force noise, which can be reduced by achieving low operation temperature, high quality factor and by increasing the length of the cantilever and reducing the cantilevers width and thickness.

*This thesis, Chapter 5.*

- The current generation of detectors, despite being approximately six orders of magnitude more sensitive than the detector on which J. Webber claimed to have observed gravitational waves more than 40 years ago, will still not be able to detect a gravitational wave signal.

- The hysteretic behaviour of a dc SQUID tightly coupled to a long input coil typically appears as steep flux-voltage characteristics, which might mislead a user to operate the SQUID in this part of the characteristics.

*J Pleikies, PhD Thesis.*

- Feedback cooling of the modes does not improve the sensitivity of the system as GW detector.

*A. Vinante, M. Bignotto, M. Bonaldi, M. Cerdonio, L. Conti, P. Falferi, N. Liguori, S. Longo, R. Mezzena, A. Ortolan et al. Feedback cooling of the normal modes of a massive electromechanical system to submillikelvin temperature. Phys. Rev. Lett. **101**, 033601, Jul (2008).*

- Given the current rate of consumption and the resource of helium, not only the vast majority of cryogenic setups has to be converted to liquid helium free systems within the next 10 years, but a single party balloon should really cost about \$100 to reflect the precious nature of the gas it contains.

Robert Richardson.

- For a typical low temperature experiment, the ratio of required time to perform the experiment to initial estimate ranges from  $\pi$  to  $\pi^2$  (i.e. one month estimate becomes 3 month to 1 year). In the case of the big projects, like MiniGRAIL, the ratio can even become  $i\pi$ .

- Never attribute to malice that which is adequately explained by stupidity.  
*Robert J. Hanlon.*

Oleksandr Usenko,  
Leiden, April 18, 2012.