

Introduction to Noise Processes
ECE730/QIC890-T33
Instructor: Professor Na Young Kim

Suggestive Topics of Term Project

Please determine the topic of the Term Project report, where you should explicitly write down

- the identification of the topic goal
(e.g. the target of the experiment and the description of the devices and systems),
- the discussion of the signal-to-noise ratio (SNR), and
- the proposal of the future experiment or research to improve the SNR etc..

Your report is not limited to the above aspects, but you should address the above for sure. Also you have to properly cite references in the report.

For those of you who do not have a concrete idea on the topic, please consider the following topics and you can dig up the right literature.

1. Fundamental Quantum Limit of External Force Detection

- (1) C. M. Caves et al., Rev. Mod. Phys. 52, 341 (1980)
- (2) H. Mabuchi, Phys. Rev. A 58, 123 (1998)
- (3) O. Alter et al., Phys. Lett. A 263, 226 (1999)

This topic will treat that the detection sensitivity is still constrained by the principle of quantum mechanics even if you completely remove all classical thermal and $1/f$ noise from a weak force detection system. Can you propose any experiment scheme to quantify fundamental quantum limit of force detection?

2. Gravitational Wave Detection Optical Interferometer

- (1) A. Abramovici et al., Science 256, 325 (1992)
- (2) C. M. Caves, Phys. Rev. D 23, 1693 (1981)
- (3) S. J. Waldman, arXiv:1103.2728 (2011)

LIGO gravitational wave detection was one of the biggest and celebrating News in Science early this year. Identify the noise sources in a laser interferometric gravitational wave detection experiment. Can you come up with an experimental setup to have the detection sensitivity at various signal frequencies in the range of 10Hz and 10 kHz?

3. Random Telegraph Signal by Single Electron Trap

- (1) H. H. Mueller et al., J. Appl. Phys. 79, 4178 (1996)
- (2) M. J. Kirton et al., Advances in Phys. 38, 367 (1989)
- (3) M. J. Uren et al., Appl. Phys. Lett. 47, 1195 (1985)

In a MOSFET, the $1/f$ noise would be attributed to interface charge traps. Can you consider the experimental scheme to detect a single charge or single spin by using the MOSFET case in terms of conductance modulation?