

Impact of Radio Frequency Fields on the Recruitment of DNA Repair Proteins

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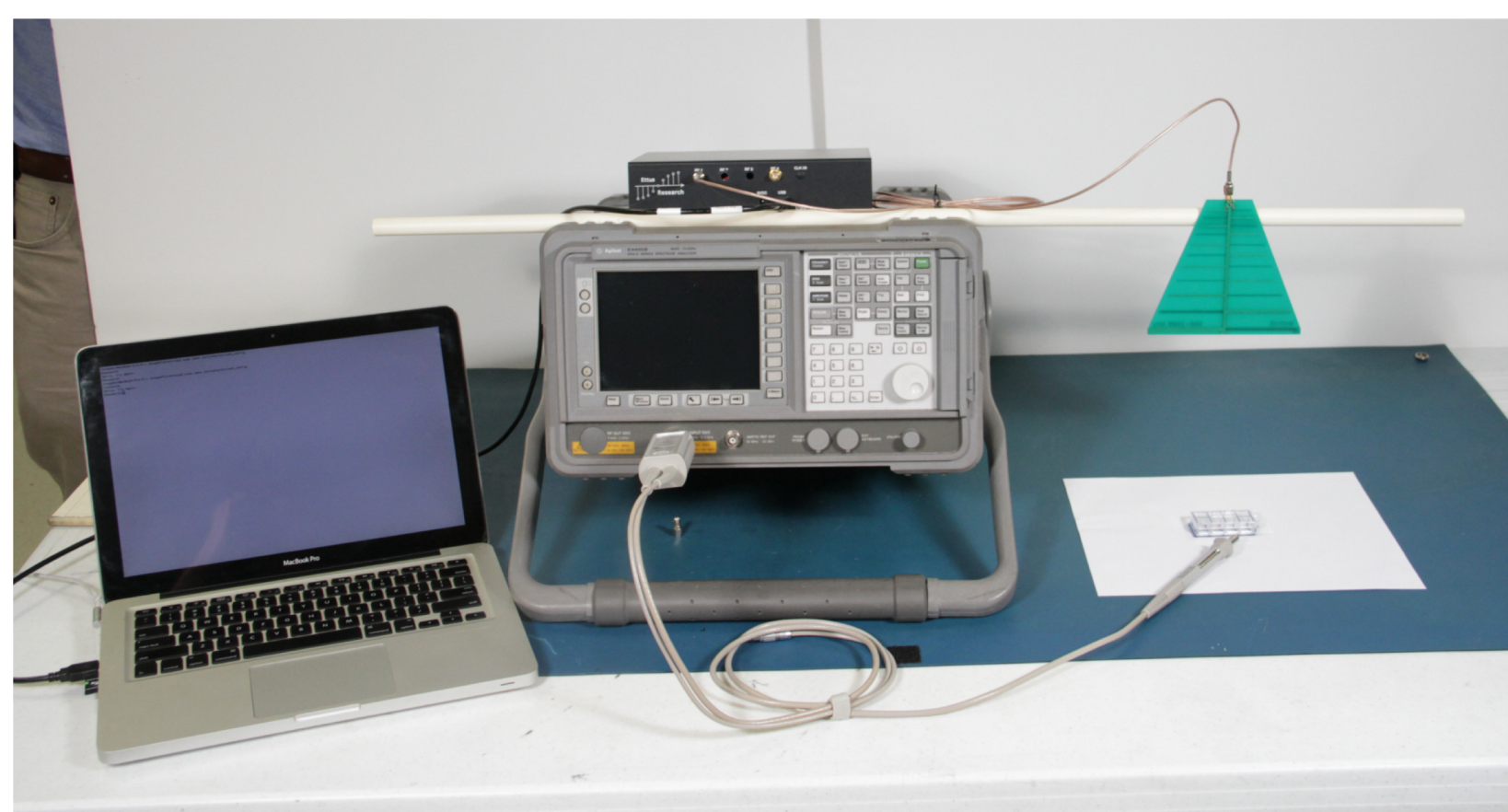
Motivation

A prime example is the recent discovery that anthropogenic electromagnetic noise can disrupt the biomagnetic compass of migratory birds. If it is possible for such low frequency electromagnetic waves to impact biological systems, it begs the question of what other biological systems the ever increasing levels of anthropogenic electromagnetic noise may be affecting [1].

Objectives

The overall goal of this research is to investigate the influences of low-frequency radio waves on a cellular level, with specific emphasis on DNA repair and transcription.

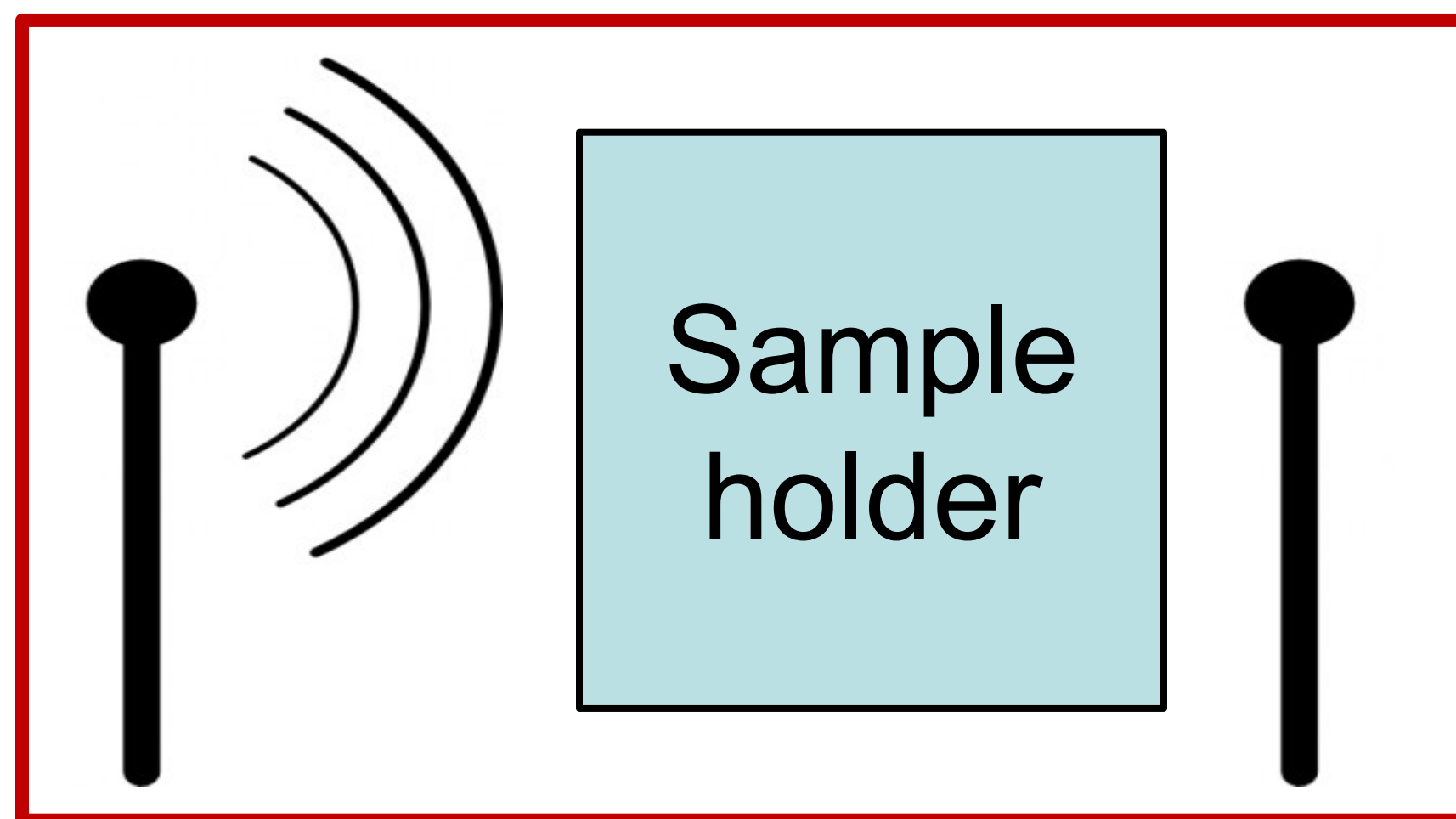
Our objective in this project is to develop an experimental apparatus to expose cell samples to electromagnetic radiation at frequencies of 1 MHz, 100 MHz, 2.4 and 5.8 GHz. This apparatus would be enclosed in an RF absorbing foam, and comprise of a transmitter, cell sample holder, and receiver.



A possible experimental setup using the spectrum analyzer, antenna, and cell sample box

Methodology

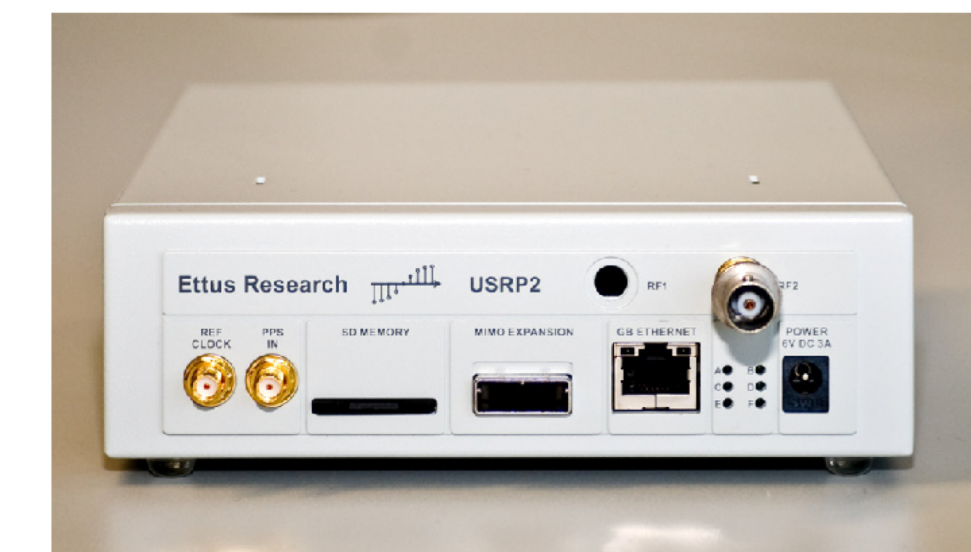
Test Chamber Design



TX

RX

In the final construction of the test chamber, we aim to line the apparatus with RF absorbing foam to mimic the effects of a complete anechoic chamber. This would reduce interference from reflected waves.



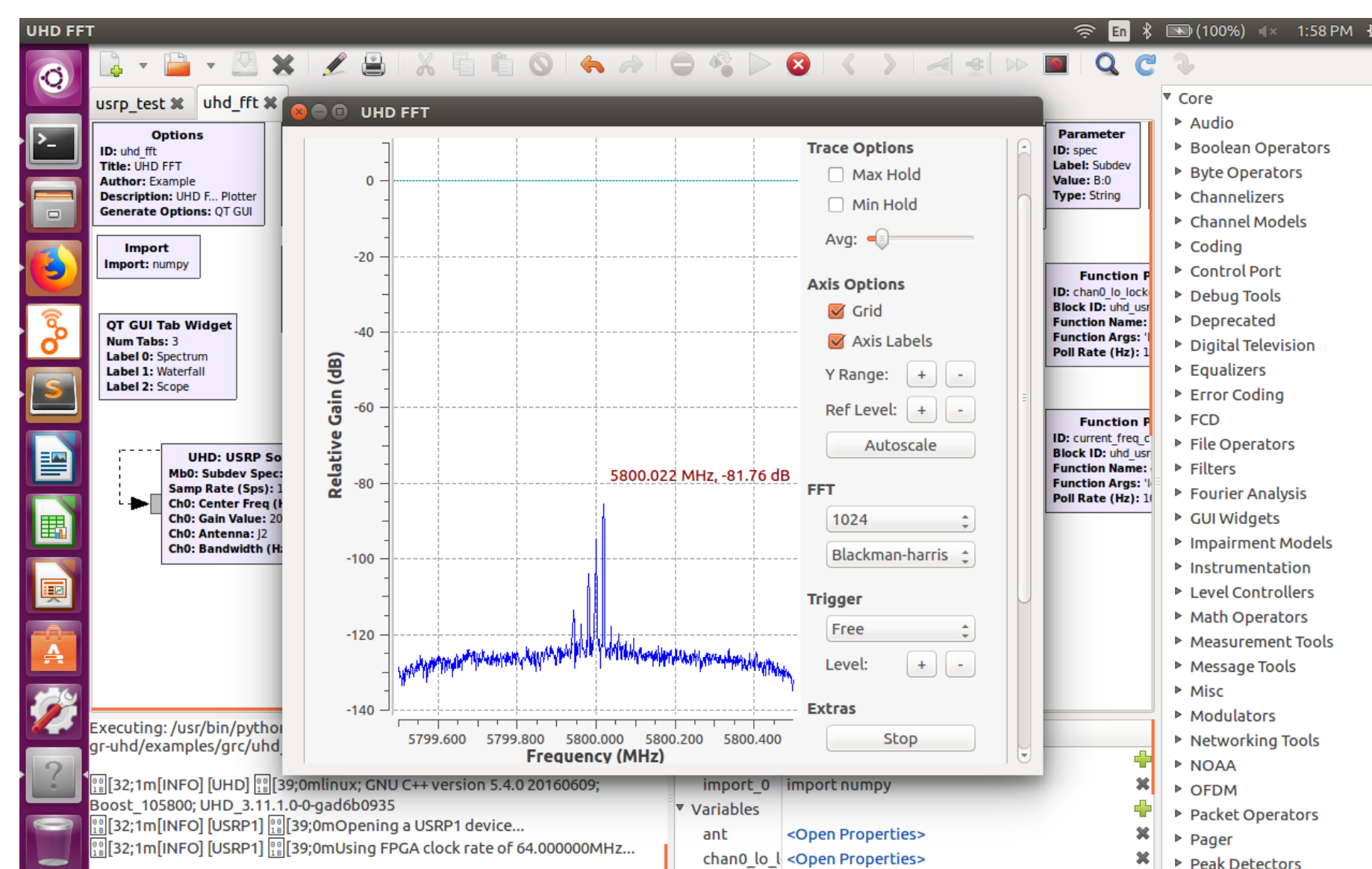
SDRs used for experimentation: USRP1 (left) and USRP2 (right)

- The USRP1's were outfitted with XCVR2450 daughterboards, which are half-duplex transceivers that work from 2.4 to 6.0 GHz
- Two USRP's were used, one as transmitter and the other as receiver
- The transmitter was set to broadcast sine waves at 2.4 and 5.8 GHz using VERT antennas. The USRP output was first visualized with a spectrum analyzer



Results

Using GNU Radio, we were able to receive and visualize the sine wave signals output from the TX USRP



We also attempted to map the broadcast intensity from an antenna constructed from a metal can.

Future Directions

The immediate goals for the project are to continue experimentation with the transmitters and receivers. Additionally, we need to perform tests to determine the dynamics of the antennas we are using. Using this information we can orient the antennas such that the maximum intensity is broadcasted towards our samples.

Our long term goals are to construct the complete box for holding the antennas and the biological samples. Additionally we would like to design an interface for controlling the transmitters like a GUI.

References and Acknowledgements

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[1] Engels, Svenja, Nils-Lasse Schneider, Nele Lefeldt, Christine Maira Hein, Manuela Zapka, Andreas Michalik, Dana Elbers, Achim Kittel, P. J. Hore, and Henrik Mouritsen. "Anthropogenic Electromagnetic Noise Disrupts Magnetic Compass Orientation in a Migratory Bird." *Nature* 509, no. 7500 (May 2014): 353–56. <https://doi.org/10.1038/nature13290>.