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An FPGA-based Trigger for the QTNM Experiment

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The Quantum Technologies for Neutrino Mass (QTNM) project aims to measure the neutrino mass through a precise measurement of the electron kinetic energy spectrum of atomic tritium beta decay. The aim is to use the newly developed Cyclotron Radiation Emission Spectroscopy (CRES) technique to make frequency measurements of radiation emitted by electrons undergoing cyclotron motion in a strong magnetic field. This frequency is directly related to the electron's kinetic energy, so a precise frequency measurement can form a precise energy measurement.
A trigger is necessary for QTNM to avoid collecting extremely large amounts of data containing no electrons of interest. However, the electrons emit very low amounts of power, so thermal and amplifier noise dominate the received signal. In addition, CRES signals are chirps that increase in frequency as the electron loses energy. These factors necessitate a more atypical form of trigger that responds to these signals in high noise conditions.
Two forms of trigger have been developed for this purpose, one matched filter trigger and one lock-in amplifier based trigger. Both have been implemented on an FPGA based system.
In this presentation, I will show the development and characterisation of the performance of these triggers on CRES-like signals for the QTNM project.

Collaboration

Quantum Technologies for Neutrino Mass (QTNM)

Role of Submitter

I am the presenter

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