***Background on current method to detect soil moisture via neutrons:***

-Currently the neutron probe used for detecting neutrons for soil moisture requires a radioactive source which provides fast neutrons.

-Since the neutron source provides a **known** flux of fast neutrons the neutron probe only detects thermal neutrons. It would be redundant for it to detect both.

-It would appear this device uses a Fourier transform to tell detected gamma rays apart from neutrons.

***Where we are:***

-Since we are currently building a thermal neutron detector first, we can ensure that our thermal neutron detector is on par with the current standard for a neutron detector soil moisture probe.

-We hope that we do not need to use Fourier transforms, though Arduino can do them.

-When we ensure that our thermal neutron detector can give us the same fast to thermal neutron ratio as the current standard, we can look into creating a fast neutron detector.

*********Note(s)*********

***Background:***

-The scintillator in simple terms is a plastic or a crystal that emits light when a gamma ray or a particle event occurs.

-The SiPM(silicone photomultiplier) is used to detect the light emitted from the scintillator.

-We are using the MIT Cosmic Watch V2 circuit board currently for the electronics read events.

-We want to use the data after collecting it for 8-10 hours when we have both detectors built so we do not need a radioactive source.

***Setup for thermal probe:***

**-**We are using a 6x6mm SensL C-Series SiPM

-We are using two Ej-426 tiles and Ej-280 wave shifting bar configuration as a scintillator (info on the scintillator setup on page 505 of Radiation Detection and Measurement in this GitHub).

-The Ej-426 tiles detect the neutrons events and the wave shifting bar turns detected events into visable light for the SiPM.

-We are using the MIT Cosmic Watch V2 circuit board, it displays data on a LED screen or SD card via it's SD card slot.

***Potential Issues:***

-Our configuration of two Ej-426 tiles and Ej-280 waveshifting bar configuration is not directly triggered by gamma ray events itself.

-However, when the Ej-426 tiles detect a neutron, the breakdown of the lithium-6 will emit a 0.48 MeV gamma ray.

-The SiPM according to SensL documentation can be triggered by directly by gamma ray events.

***Suggested resolutions for potential issues should they arise:***

(1) A Fourier transform may be needed to differentiate between gamma ray events and neutrons detected by the scintillator configuration. Arduino has many libraries to perform a fast Fourier transform(FFT), we just need to ensure that we can read the waveform of the SiPM to do the FFT. The current MIT Cosmic Watch V2 on the O-scope at the test point(TP3) going to the analog pin on the Arduino Nano showed the waveform.

(2) Another possibility is to have the Arduino just collect the waveform data and then perform the FFT on a computer. Performing a FFT on the Arduino itself can be notoriously expensive for space. Using the SD card slot or transmitting the data to a computer are both options to save space on the Arduino. The SD card may be the most practical solution since when the full system is built we will want to use the data after 8-10 hours.