NERVE IMPULSES & MAGNETIC FIELDS

Mission Objectives

The **nervous impulse** is transmitted in the human body as an electric signal, with a voltage created by the movement of ions between the inside of the nerve and the sheath that covers it. Due to the **different intensity of the magnetic field**, and the presence of Van Allen belts, this impulse could vary when it operates in Low Earth Orbit environment. Our goal is to **find out how this impulse is influenced** by radiation, in order to predict the **possible effects** on astronauts during **Extra-Vehicular Activities** in the areas affected by radiations, for example the orbit of the ISS (altitude: ~400 km): for this reason, our experiment will be positioned in LEO but not necessarily bounded to ISS.

The experiment will consist of a **simple connection between two microcontrollers** which will be exchanging data in the form of an Alternating Current signal, where the movement of the electrons is as much as possible **similar** to how the sodium / potassium pump located in the walls of the nerve cell works, where electric tension is formed at local level. This voltage is called "**action potential**", and it works using the loss of a positive charge thanks to the ions exchange. By sending these signals at pre-established moments, we will be able to **observe their variation** as the mission goes on; thus having the possibility of studying the long-term variation of the **voltage** of the recorded signal and the **time taken** by the different signals to reach the second controller, which sends us the data in order to **compare them** with the results of an observation carried out on Earth.

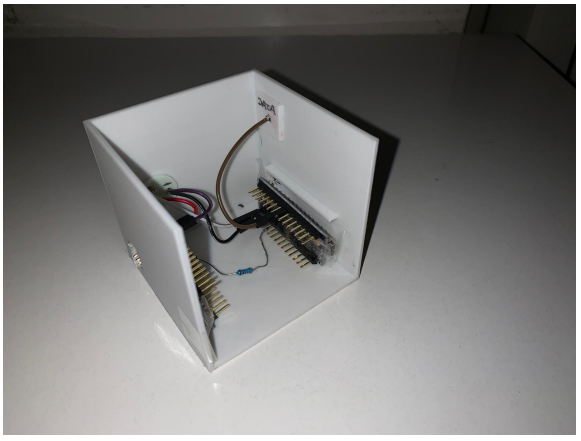
Proposed Method

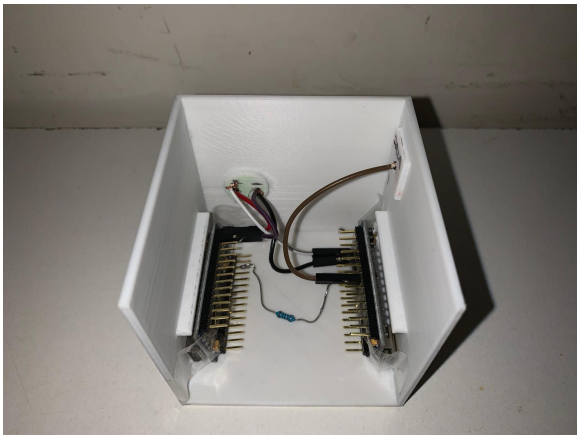
The experiment will involve two microcontrollers, one sending an impulse to the other passing through a **98kΩ** resistor, in order to simulate the environment of a nerve fibre.

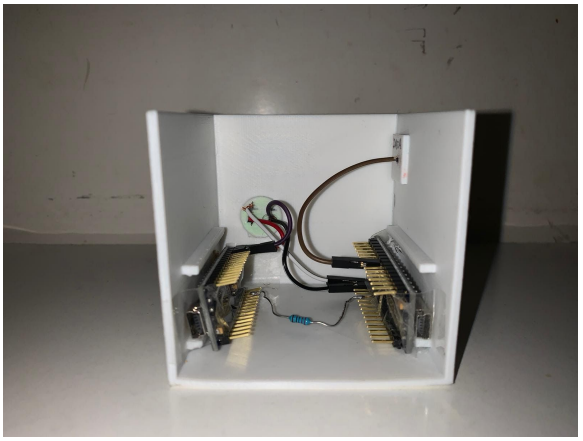
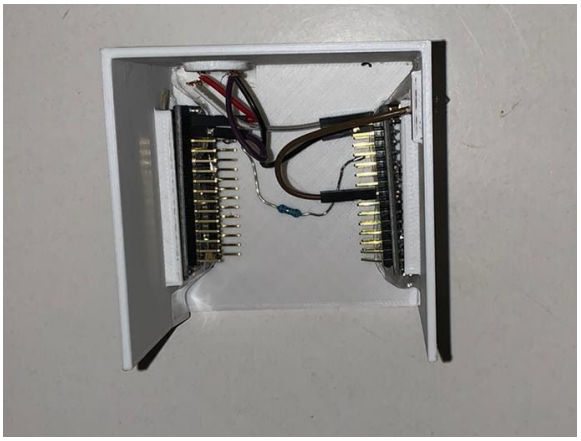
The **energy required** to power the modules and send the signals is supplied directly by the Cube-SAT, which is enough to ensure the right power supply (in fact, the average total power required by our experiment will be around **0.2W**, less than the half permitted which is 0.5W).

The receiving module will **communicate with the proper Cube-SAT protocol** in order to send us the calculated data (they will be about 0.5 Mb sending one impulse per second, and could decrease a lot if we decided to send the average values, for example, every 100 impulses), and we will be able to compare them with a similar experiment realized on the surface of the Earth, representing them in a graph that tracks the trend of the **following parameters**:

- Signal **voltage** (and intensity thanks to the known resistance);
- Signal **wave frequency**;
- **Time interval** between the various signals received.

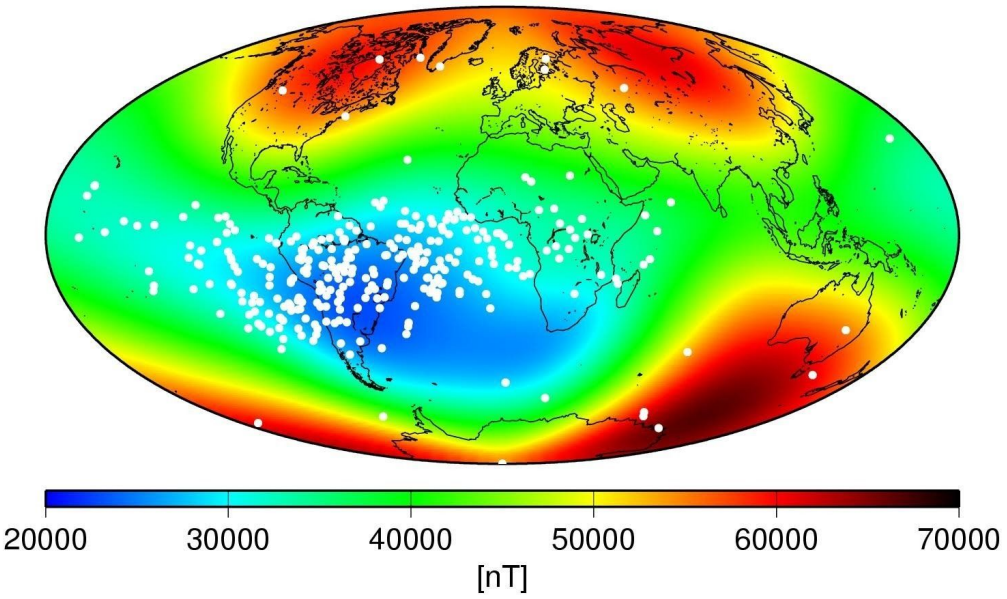




Scientific/Technological Aspects

- Nerve impulse **parameters**;
- Data reading of a variable **electric signal**;
- Data **transfer**;
- Influence of **magnetic field** on the nerve impulse;
- Electromagnetic radiation in **LEO** environment;
- Ionizing radiation of the lower Van Allen belts, in particular in the **South Atlantic Anomaly**, an area of intense radiation at quite low altitudes (it can reach 200 km of altitude);
- **Simulation of a nerve fibre** using an electric cable, considering action potential and nerve resistance.



Representation of the intensity of the Earth's magnetic field: as we can see, in the area of the Southern Atlantic Ocean the field is weaker, leaving us more exposed to radiation.

Credit: ESA