Mission Space Lab Phase 4 report

Team name: PiNuts

Chosen theme: Life in Space

Organisation name: Aarhus Tech

Country: Denmark

Introduction

In a world that is forever becoming more digitalized, solar storms and solar winds are posing an even greater threat to our critical infrastructure and society as a whole. Especially for the astronauts on board the ISS whose whole survival depends on electronics. We know from swpc.nooa.gov that the sun is heading into an earlier than usual activity phase, therefore we would like to use the AstroPi on board the ISS to measure the magnetic fields strength and see if this earlier than usual activity from the sun, means that it might be possible to see variations on short studies like 3-hour observations. We would then time stamp the strength of the magnetic fields and find photos of the sun to the corresponding time uploaded on NASA. This would give us the opportunity to look for certain patterns on the sun, letting us "predict" a solar storm beforehand, which could actually be used in the future to predict solar storms in advance and give the astronauts and society on earth time to prepare.

Method

Since we have decided to measure the magnetic field around the space station, our mission utilised the built-in magnetometer on the SenseHat. Other than that, we used the GPS to get the location of the space station at the time of measuring. To access and acquire the data from these components, we wrote a Python program that extracted the data and transferred it into a CSV-file, that was stored on the Raspberry Pi. The data that was written to the CSV-file also contained a timestamp to get a time reference between the measurements, as well as error descriptions in case anything went wrong. The analysis of the data was solely conducted back on earth, of which the results are shown in the next section.

In and of itself, this method is not a terrible way of acquiring magnetic data. Although in the context of get solar data, there is a minor downside in the earth’s magnetic field and magnetically isolating property, which will be discussed further in later parts.

Experiment results

Two different graphs were created from the data gathered from the experiment. The first graph depicts the magnetic flux density on the 3 different axes, with the Raspberry Pi in origin. Lastly there is also a graph which depicts the total magnetic flux density.

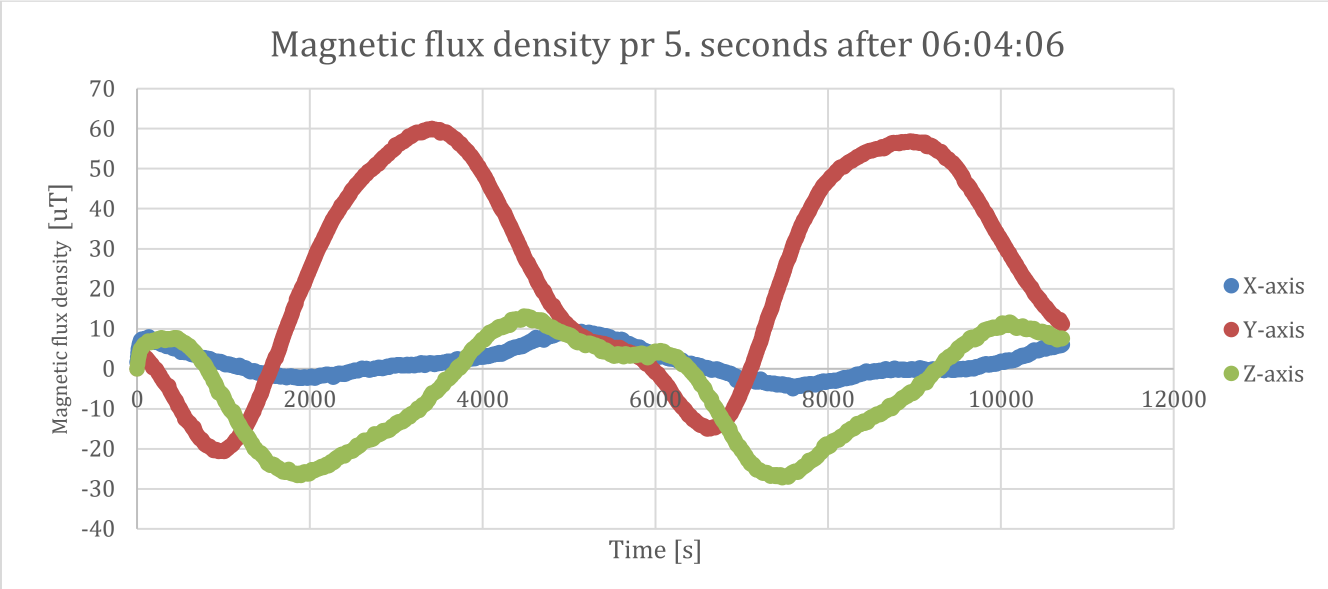

Figure 1: Magnetic flux density x-axis, y-axis, and z-axis

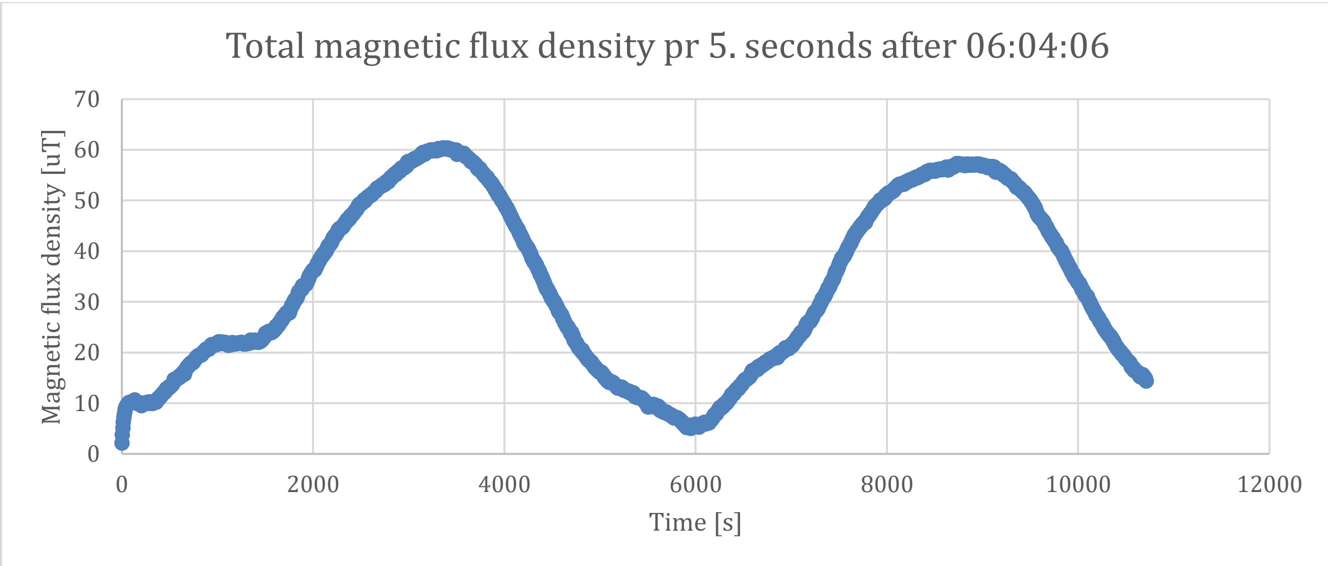

Figure 2: Total magnetic flux density

The most important result to denote from these graphs, is the almost periodic highs and lows of the magnetic flux density. This is the result of the experiment's 3-hour duration. Since the ISS takes 1.5 hours to do one full orbit, the highs and lows on the graphs depicts this movement. To circle back to the original mission, this also shows that most of the magnetic flux density, that the ISS experiences, doesn't derive from earth, since the graphs would be way more linear. Thereby it is fair to assume that most of the magnetic flux density derives from the sun and its activities.

The difference in the peaks of the graph, probably stems from the fact that ISS is always moving up and down the Earth while orbiting. Thereby the ISS isn't at the same point on earth with each rotation, which may therefore affect the total magnetic flux density received on the space station.

The point of the experiment was to test the possibility of detecting the suns influence on the magnetic field Therefore, solar activity data from the time of the experiment was found.[1] The most interesting peaks happened around 7. O'clock and half past 7.

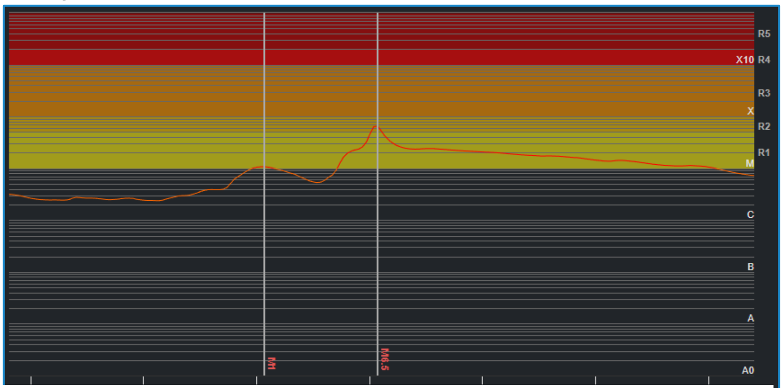

Figure 3: The suns x-ray activity from 6:00 till 9:00

Furthermore, another graph was made to fit in between this interval, to see if it was possible to detect the solar activity:

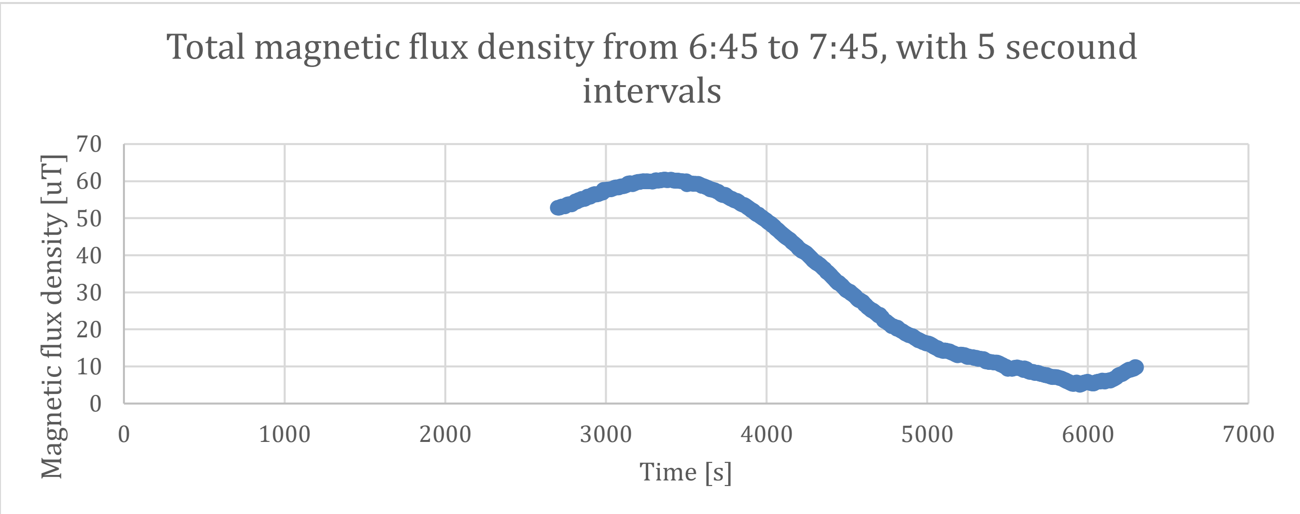

Figure 4: Total magnetic flux density from 6.45 to 7.45

[1] https://www.spaceweatherlive.com/en/archive/2023/05/20/xray.html

Learnings

The main challenge of working together as a team, was the important aspect of communication. The team consists of three last year students, and two second year students, meaning everyday interaction is limited. The solution was to create a common server on social media, where everyone could communicate and share progress. Furthermore, our teachers were added to the server, meaning they were easier to get a hold of, which optimized the workflow.

In this process, the team has also learnt to use each other's differences and diversity as an advantage. Early in the process, it was discovered that everyone on the team had different skillsets. Some exceeded in coding, while others were better at problem solving, writing, or analysing, while everyone had at least some experience in all skills. Thereby each team member could have specialized tasks, while still being able to get help or talk to other team members, as well as our teachers.

Conclusion

The project set out to investigate if solar activity could be measured directly from the affect upon the magnetic field on the ISS, by measuring the magnetic flux density onboard with a Raspberry Pi that was connected to a magnetometer.

The results were then plotted and analysed. Firstly, the ISS's rotation around the earth could be seen with the periodic peaks and lows. Furthermore, the suns activity was found online, here it was shown that the sun was more active around 7:00, again at 7:30 and furth, and there would be a low between these two highs.

From the data gathered it cannot clearly be concluded that the suns activity affects the magnetic field. Firstly the 2 peaks aren't equally high, this could be the result of the suns activity but might also be because of the different orbital paths of the ISS. Secondly the suns activity might be seen reflected in the data results, the first high and the low in between might be there, but the second and continuous high isn't. This could be explained by stating that the ISS was behind the earth at that time, but this cannot be concluded by the limited data gathered.