First European Astro Pi Challenge
2016 - 2017

Phase 1 - Describe your experiment idea

In order to demonstrate your motivation and creativity and receive an Astro Pi kit, come up with an experiment *idea* to be run using the Astro Pi on the ISS and its sensors (Sense Hat); then describe this idea using the fields below, identifying all the necessary steps that will enable you to run your experiment (*no coding needed at this stage: only an experiment idea!*).

The idea can be related to different aspects of life and work on the ISS. Search for cosmic rays? Record a loss of altitude or acceleration of the ISS? Or perhaps just detect crew movement?

The more creative, rich, and original your idea is, the more you will be able to demonstrate your motivation, and the bigger chance you will have to be selected for Phase 2 of the challenge. If your team is selected, you will also receive an ESA-branded Astro Pi kit, including all its sensors and components, directly at your school for free!

Our idea is to investigate….
That critical ISS systems work fine and otherwise alarm early the astronauts.
Temperature and humidity inside the station slightly varies depending on ISS location (i.e. in Earth's shade or not) and are also related to astronauts' activities like working, exercising, relaxing or sleeping. If values measured from the sensors are outside limits, that should raise an alarm because there may be a Cabin Heat Exchanger problem, a fire on board, or just indicate that astronauts sleep for too long or work/exercise overtime!
Due to the O2 re-pressurisation system, it is expected that at least once every 2 hours a high pressure would be measured in the Barometric Sensor. Otherwise, the oxygen system may have a function problem and astronauts' life may be in danger.
ISS travels at constant speed but the Accelerometer detects an acceleration every time the thrusters are used to re-boost because the station gradually loses height. If this regular acceleration is not detected, Astro Pi should alarm since there may be a malfunction with the thrusters.
If ISS thrusters from re-boosting are malfunctioning or if ISS is hit by any moving object like debris or a meteoroid, then it may start rotating fast (rolling). This is an undesirable situation and the Astro Pi will trigger a proper alarm.
Solar wind intense bursts or travelling inside the Val Allen radiation belt could damage sensitive electronic equipment that is located inside or outside the ISS. Great variations in periodic Magnetometer readings would set an alarm so that astronauts employ the radiation shielding.

Table 1. Investigation Steps

STEPS	DESCRIPTION	SKILLS/ KNOWLEDGE REQUIREMENTS
Astro Pi will work as a smart alarm system as triggered by the sensor readings. All 6 different sensors are used.	*One student team organized in 6 subgroups. Each subgroup deals with one of the six available Astro Pi sensors.*	Sensor operation. Teamwork spirit. Communicative skills.
Take Periodic Temperature and Humidity readings from the 2 sensors	*If values measured from the Temperature & Humidity sensors are outside limits alarm is set. If Temperature or Humidity increase or decrease rapidly then alarm is set, i.e. Astro Pis LED start flashing and suitable text message scrolls. Function can be tested by us by presenting Astro Pi near a small fire.*	Previously taken real ISS readings data must be available, like the Astro Pi Flight Data Analysis (www.raspberrypi.org/learning/astro-pi-flight-data-analysis/) in order to determine the acceptable range of values and the acceptable rate change of temperature/humidity for healthy life inside the ISS. Python programming, Raspberry Pi.
Take Periodic Barometric Pressure Sensor readings	*Check that O2 re-pressurisation system works. If a high pressure is not recorded at least once every 2 hours Astro Pis LED start flashing and suitable text message scrolls. Function can be tested by us by presenting Astro Pi near a suitable air flow from a ventilator.*	Astro Pi Flight Data Analysis on real data to determine values recorded when an O2 re-pressurisation takes place. Python programming, Raspberry Pi.
Take Periodic Accelerometer readings	*If a suitable re-boost acceleration is not recorded every now and then, an alarm is set because the thrusters may be malfunctioning and ISS may be losing height. Function can be tested by us by presenting Astro Pi a suitable sudden acceleration.*	Astro Pi Flight Data Analysis on real data to determine values recorded when the thrusters are used to re-boost ISS. Python programming, Raspberry Pi.
Take Periodic Gyroscope readings	*ISS fast rolling around itself is an undesirable situation and crew must be warned. There may be the case ISS has just*	Astro Pi Flight Data Analysis on real data to determine abnormal values perhaps recorded from the

	hit an object or debris or meteoroid and stabilizing re-boosting has to take place. Thus Astro Pi will raise a proper alarm. Function can be tested by us by rolling around the Astro Pi.	Gyroscope. Python programming, Raspberry Pi.
Take Periodic Magnetometer readings	*Abnormal sensor values may indicate Solar wind intense bursts or travelling inside the Val Allen radiation belt thus the crew has to be alarmed to take radiation measures. Function can be tested by us by bringing Astro Pi close to magnetic fields.*	Astro Pi Flight Data Analysis on real data to determine abnormal values perhaps recorded from the Magnetometer. Python programming, Raspberry Pi.
Reset function	*Astronauts can reset the Astro Pi alarm when proper action has been taken to deal with the raised alarm incident.*	Python programming, Raspberry Pi.