

## **Send your computer code into space with British ESA astronaut Tim Peake**

### **UK space organisations team up with Raspberry Pi to launch out of this world competition**

Leading UK space organisations have joined forces with British ESA Astronaut Tim Peake and Raspberry Pi to offer students a chance to devise and code their own apps or experiment to run in space. Two Raspberry Pi computers are planned to be flown to the International Space Station (ISS) as part of Tim's 6 month mission and both will be connected to a new "Astro Pi" board, loaded with a host of sensors and gadgets.

Launched today (10 Dec 2014) at an event held by the UK Space Agency, the Astro Pi competition will be officially opened at the BETT conference (21-24 January) and will be open to all primary and secondary school aged children who are resident in the United Kingdom. The competition will be supported by a comprehensive suite of teaching resources that are being developed by ESERO-UK and Raspberry Pi.

During his mission, Tim Peake plans to deploy the Astro Pi computers in a number of different locations on board the ISS. He will then load up the winning code whilst in orbit, set them running, collect the data generated and then download this to Earth where it will be distributed to the winning teams.

Speaking at the Astro Pi launch event, Dr David Parker, Chief Executive of the UK Space Agency, also revealed that the UK Space Agency has been given a £2 million programme, as part of the Chancellor's Autumn Statement, to support further outreach activities around Tim's mission, particularly to help inspire interest in STEM subjects.

Business Secretary Vince Cable said:

"So much technology relies on big data but not enough people are being trained in this field. This challenge helps the next generation to have fun whilst learning the skills that industry need.

"Creating tomorrow's engineers is part of our industrial strategy that gives a long term commitment to world-class skills."

Tim Peake added:

"I'm really excited about this project, born out of the cooperation among UK industries and institutions. There is huge scope for fun science and useful data gathering using the Astro Pi sensors on board the International Space Station. This competition offers a unique chance for young people to learn core computing skills that will be extremely useful in their future. It's going to be a lot of fun!"

To help students on their way in developing their code, five inspirational themes have been devised to stimulate creativity and scientific thinking. The themes are

Spacecraft Sensors, Satellite Imaging, Space Measurements, Data Fusion and Space Radiation.

In the primary school age category, teams will be asked to devise and describe an original idea for an experiment or application which can be conducted on the Astro Pi by Tim during his mission. The two best submissions will get the opportunity to work with the Astro Pi team to interpret their ideas and the team at the Raspberry Pi Foundation will then code them ready for flight on the ISS.

In the secondary school age group, the competition will be run across three age categories, one for each of Key Stages 3, 4 and 5 (in England and Wales, and their equivalent ages in Scotland and Northern Ireland). In the first phase, competitors can submit their ideas for experiments and applications. At least the best 50 submissions in each age category will win a Raspberry Pi computer and an Astro Pi board on which to code their idea. In phase 2, all teams will develop code based on their original concept and two winning teams will be selected in each age category. The winning teams' code will be readied for flight by the Raspberry Pi Foundation and CGI.

As well as having their code uploaded to the ISS, all winning teams will each receive a class set of Raspberry Pi and Astro Pi boards, meet the Astro Pi team and participate in a winners event during Tim's flight.

In addition to the main prizes, each of the UKspace companies supporting the project have offered a prize. These prizes will be awarded to the best submission associated with each of the themes, across the age ranges.

ESERO-UK and Raspberry Pi are developing a comprehensive suite of teaching resources to link to the curriculum and assist teachers of STEM subjects in engaging their students in the competition. As well as explaining how to use and write code for the Astro Pi and its sensors, the resources will provide a context for the Astro Pi in the curriculum and link to teaching subjects and areas.

The first two resources of the series are available now in the [National STEM Centre eLibrary](http://www.nationalstemcentre.org.uk/elibrary/collection/2008/astro-pi) at <http://www.nationalstemcentre.org.uk/elibrary/collection/2008/astro-pi> and the rest will follow.

Launching the Astro Pi computers, and consequently the successful implementation and completion of this competition is subject to nominal progress through the ESA integration programme and operations on-board the ISS.

The organisations involved in the Astro Pi competition include the UK Space Agency, UKspace, Raspberry Pi, ESERO-UK and ESA.

The UKspace team, led by SSTL, include Airbus DS, CGI, the Space KTN, National Nuclear Laboratory and National Physical Laboratory.

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## Images

### Images of Tim Peake

<http://www.flickr.com/photos/bisgovuk/4453909527/>

<http://www.esa.int/spaceinimages/content/search?SearchText=Timothy+Peake&img=1&SearchButton=Go>

### Astro Pi logo

[https://space.blog.gov.uk/wpcontent/uploads/sites/129/2014/12/Astro\\_Pi\\_Logo\\_WEB.png](https://space.blog.gov.uk/wpcontent/uploads/sites/129/2014/12/Astro_Pi_Logo_WEB.png)

### Raspberry Pi images

[https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/PI\\_Overhead\\_ALPHA.jpg](https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/PI_Overhead_ALPHA.jpg)

[https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/Pi\\_1.jpg](https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/Pi_1.jpg)

[https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/Pack\\_Shot.jpg](https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/Pack_Shot.jpg)

[https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/PI\\_Overhead.jpg](https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/PI_Overhead.jpg)

<https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/Pi.jpg>

[https://space.blog.gov.uk/wpcontent/uploads/sites/129/2014/12/Pack\\_Shot\\_Overhead.jpg](https://space.blog.gov.uk/wpcontent/uploads/sites/129/2014/12/Pack_Shot_Overhead.jpg)

[https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/IMG\\_0051.jpg](https://space.blog.gov.uk/wp-content/uploads/sites/129/2014/12/IMG_0051.jpg)

### Astro Pi clip

<http://youtu.be/QfysNo77qM4>

### Tim Peake

Tim Peake will be starting his 6 month mission to the ISS in November 2015.

**Tim Peake's biography can be found at:**

[http://www.esa.int/Our\\_Activities/Human\\_Spaceflight/Astronauts/Timothy\\_Peake](http://www.esa.int/Our_Activities/Human_Spaceflight/Astronauts/Timothy_Peake).

## **Links**

[www.astro-pi.org](http://www.astro-pi.org)

## **Notes for editors**

### **1. Competition themes**

#### **THEME 1: Spacecraft Sensors**

Satellites not only provide a unique perspective of our planet but also allow us to explore the Universe. To do this effectively, satellites house a wide array of instruments to detect their surrounding environment, called sensors. Similar to how we use a compass on the ground to point towards North, satellites use magnetometers to sense the Earth's magnetic field to determine which direction they are pointing. Satellites also have gyros and accelerometers which are used to detect how their orientation is changing, similar to how your tablets and smartphones know which way you turn them. How would you use the sensors on the Astro Pi to calculate your orientation or to tell you about what's going on in the ISS?

#### **THEME 2: Satellite Imaging and Remote Sensing**

Satellites often carry imagers on-board to take pictures of Earth, other planets, comets, and even galaxies. These images are not only beautiful but have locked within them a vast amount of information waiting to be explored. The field of remote sensing uses image processing techniques and an understanding of the electromagnetic spectrum to acquire information of objects from afar. For example, remote sensing can be used by farmers to monitor crop health, by fire fighters to detect forest fires, and coast guards to detect oil spills in the oceans. The Astro Pi has a camera on each board working at either visible or infra-red wavelengths which you can use to image inside the ISS or out of a window. What would you do with these cameras?

#### **THEME 3: Space Measurements**

Every aspect of human activity involves measurement of some type and it is a critical part of many applications including the space industry. The Astro Pi has a range of devices attached to it which can measure everything from the time of day to the humidity in the ISS. A single data point from any one device is going to have a large uncertainty attached to it. Can you find ways to combine multiple data points and calibrate devices in orbit to reduce the uncertainty? What would you do to improve the accuracy of the measurements you can make with the Astro Pi and how will you demonstrate this?

## THEME 4: Data Fusion

In space and on the ground you often derive information from multiple sensors that could not be obtained via one sensor operating alone. Satellites frequently do this by processing multiple data sources to learn new things about the environment they're observing. With the Astro Pi it may also be possible to demonstrate correlations between the data collected by two or more sensors. An example of this could be demonstrating that an increase in the radiation environment, (which could be measured by the camera), leads to an increase in the drag experienced by the station, and hence a shorter time period between orbit maintenance manoeuvres, (which could be measured by the gyro). Two Astro Pi computers are planned to be launched to the ISS, so could you design an experiment that fuses data from two different locations, or uses the peripherals in different ways on the two units?

## THEME 5: Space Radiation

Space is a hostile environment full of high energy radiation which is damaging to materials, electronics and human life! On Earth we are shielded by our atmosphere. In space, the structure of the spacecraft or a space suit has to provide adequate protection. However, very high energy particles such as galactic cosmic rays or energetic trapped protons can penetrate both a space station and the Earth's atmosphere. You might be able to use the Astro Pi camera to record these particles as they pass through the Astro Pi camera's detector. You could also compare what you see on the ground with what you see on the ISS. Or you could even launch an Astro Pi on a weather balloon and compare what you see at a high altitude in the Earth's atmosphere. How would you go about doing this?

## 2. Astro Pi Board Specifications

The Astro Pi Board will comprise the following sensors and gadgets:

- Gyroscope, accelerometer and magnetometer sensor
- Temperature sensor
- Barometric pressure sensor
- Humidity sensor
- Real time clock with backup battery
- 8x8 RGB LED display
- Several push buttons
- A camera attachment on the first board
- An infra-red camera attachment on the second board

## 3. Astro Pi on board the ISS

Launch of the Astro Pi computers and subsequent use on board the ISS are still subject to nominal progress in the certification of the hardware, successful launch to the ISS and ISS operations.

#### **4. Important Dates**

21-24 January 2015:	Competition officially opened at the BETT conference
3 April 2015:	Primary school age competition closes
3 April 2015:	Deadline for secondary school age teams to submit their concepts and have the chance to receive an Astro Pi board and Raspberry Pi computer
29 June 2015:	Final deadline for secondary school ages teams to submit their code and full entries.

#### **5. Theme Prizes**

There are also special prizes for:

The best submission in the Spacecraft Sensors theme will win a tour of Surrey Satellite Technology's premises in Guildford where the winning team will get an opportunity to get up close with some real satellites before they're launched into space.

The best submission in the Satellite Imaging and Remote Sensing theme will win a tour of Surrey Satellite Technology's premises in Guildford where the winning team will get an opportunity to get up close with some real satellites before they're launched into space.

The best submission in the Space Measurement theme will win two radio controlled clocks traceable to NPL atomic clocks and a half day trip to the NPL facilities

The best submission in the Data Fusion theme will win a tour of Airbus Defence and Space's premises in Stevenage where the winning team will get an opportunity to get up close with some real satellites before they're launched into space.

The best submission in the Space Radiation theme wins a trip to the National Nuclear Laboratory and an insight into some of the exciting work being undertaken to support nuclear power, both on earth and in space.

A further prize will be selected from all entrants for Excellence in Coding. The team will be invited to CGI's Leatherhead, Surrey offices to engage in a hackathon-type activity with CGI staff involved in space missions.

#### **6. Surrey Satellite Technology Ltd (SSTL)**

SSTL was formed by researchers at the University of Surrey in 1985. It has since gone on to be the world's leading builder of small satellites. A global company with its headquarters in Guildford, UK, it has built spacecraft and space hardware which circles the Earth and has landed on both the Moon and a comet!

## **7. Airbus Defence and Space**

The European leader in the space industry. Airbus Defence and Space is the global No. 1 for commercial launchers and the European leader for satellites and orbital systems. With its unique expertise, the company serves the space agencies of the European Union, France, Germany, Spain and the USA, national defence and civil agencies as well as commercial customers.

## **8. CGI**

CGI is a global information technology (IT) and business process services company, with offices at 17 locations in England, Scotland and Wales. CGI has an industry-leading track record of delivering 95% of projects on-time and on-budget, aligned with clients' business strategies to achieve top-to-bottom line results.

## **9. National Nuclear Laboratory**

The UK's National Nuclear Laboratory (NNL) offers an unrivalled breadth of technical products and services to our customers across the whole nuclear industry. Covering the complete nuclear fuel cycle from fuel manufacture and power generation, through to reprocessing, waste treatment and disposal and including defence, new nuclear build and Homeland Security. NNL provides these services supported by an impressive range of facilities and links with international research organisations, academia and other national laboratories. NNL's facilities are second to none. The Central Laboratory at Sellafield is the most modern nuclear research facility in the world.

## **10. National Physical Laboratory**

National Physical Laboratory (NPL) is the UK's National Measurement Institute, and is a world-leading centre of excellence in developing and applying the most accurate measurement standards, science and technology available. NPL employs over 500 scientists, based in south-west London. Our laboratory is a 36,000 square-metre purpose built measurement building with 388 of the world's most extensive and sophisticated measurement science laboratories.

## **11. Space KTN**

The Knowledge Transfer Network (KTN) is the UK's innovation network; bringing together businesses, entrepreneurs, academics and funders to develop new products and services. We help business to grow the economy and improve people's lives by capturing maximum value from innovative ideas, scientific research and creativity. We manage a community of innovators with 60,000+ members across 17 industry networks and 17 cross-sectors groups and bring people together at hundreds of events with over 6000 delegates per year.

The Space Team at the KTN works across the Space sector with companies, universities and government; helping people connect with knowledge and funding to accelerate innovation, find new applications of space technology and helping those who want to start out in the space industry.

## **12. Raspberry Pi Foundation**

The Raspberry Pi Foundation is a registered educational charity (registration number 1129409) based in the UK. Our Foundation's goal is to advance the education of adults and children, particularly in the field of computers, computer science and related subjects.

The Raspberry Pi Computer is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.

What's more, the Raspberry Pi has the ability to interact with the outside world, and has been used in a wide array of digital maker projects, from music machines and parent detectors to weather stations and tweeting birdhouses with infra-red cameras. We want to see the Raspberry Pi being used by kids all over the world to learn to program and understand how computers work.

## **13. UK Space Agency**

The UK Space Agency is at the heart of UK efforts to explore and benefit from space. It is responsible for all strategic decisions on the UK civil space programme and provides a clear, single voice for UK space ambitions.

The Agency is responsible for ensuring that the UK retains and grows a strategic capability in the space-based systems, technologies, science and applications. It leads the UK's civil space programme in order to win sustainable economic growth, secure new scientific knowledge and provide benefits to all citizens.

The UK Space Agency:

- Co-ordinates UK civil space activity
- Encourages academic research
- Supports the UK space industry
- Raises the profile of UK space activities at home and abroad
- Increases understanding of space science and its practical benefits
- Inspires our next generation of UK scientists and engineers
- Licences the launch and operation of UK spacecraft
- Promotes co-operation and participation in the European Space programme

## **14. ESERO-UK**

ESERO-UK, also known as the UK Space Education Office, aims to promote the use of space to enhance and support the teaching and learning of



Science, Technology, Engineering and Mathematics (STEM) in schools and colleges throughout the UK.

Funded primarily by the European Space Agency (ESA) and the Department for Education, ESERO-UK:

- Shares good practice, and space-related teaching and learning resources, with teachers and college lecturers.
- Aims to be the first point of contact for the education and space communities when seeking information about space education and careers.
- Raises the profile of the education work of the ESA, the UK Space Agency and the wider UK space community with schools and colleges.

This is achieved through:

- the ESERO-UK website, [www.esero.org.uk](http://www.esero.org.uk), through which teachers can access the collection of space resources within the National STEM Centre eLibrary
- a group of Space Ambassadors throughout the UK, who build and maintain space education networks that bring coherence to the space education community and provide support to schools and colleges
- high quality professional development and support to teachers across the UK
- news about national, regional and European events of interest to educators

ESERO-UK is part of a wider network of ESERO offices in ESA member states. The European Space Education Resource Office (ESERO) project is ESA's main way of supporting the primary and secondary education community in Europe ([http://www.esa.int/Education/Teachers\\_Corner/European\\_Space\\_Education\\_Resource\\_Office](http://www.esa.int/Education/Teachers_Corner/European_Space_Education_Resource_Office)).

## **15. European Space Agency**

The European Space Agency (ESA) provides Europe's gateway to space.

ESA is an intergovernmental organisation, created in 1975, with the mission to shape the development of Europe's space capability and ensure that investment in space delivers benefits to the citizens of Europe and the world. It has twenty Member States and Cooperation Agreements with six Member States of the EU. Canada takes part in some ESA programmes under a Cooperation Agreement. ESA is also working with the EU on implementing the Galileo and Copernicus programmes.

By coordinating the financial and intellectual resources of its members, ESA can undertake programmes and activities far beyond the scope of any single European country.

ESA develops the launchers, spacecraft and ground facilities needed to keep Europe at the forefront of global space activities.

Today, it develops and launches satellites for Earth observation, navigation, telecommunications and astronomy, sends probes to the far reaches of the Solar System and cooperates in the human exploration of space.

Learn more about ESA at [www.esa.int](http://www.esa.int)

**Ends**