Midlands Innovation CubeSat Newsletter

July 2022 WUSAT-3

Warwick – Aston – Birmingham – Cranfield – Keele – Leicester – Loughborough – Nottingham

Welcome to WUSAT-4!

An exciting new mission to provide In-orbit Demonstration for Industrial and Research Payloads!

In recent months a decision was made to mothball the WUSAT-3 mission for the time being (see 'WUSAT-3 Mission' below). However, we have immediately entered a very exciting new mission (WUSAT-4) that will carry both an **industrial payload** on behalf of **UK Launch Services Ltd (UKLSL)**, and a **research payload** on behalf of the **University of Exeter** and their engineering partner (**Space Park Leicester**).

The industrial payload, code named **BEAP** (Beacon for Evaluation of Attitude and Position) is being developed by UKLSL. Its purpose is to provide information on the location and orientation/stability of Space objects in orbit. It aims to provide a novel Space Surveillance & Tracking (SST) service which would allow most future satellites and launch vehicles to be actively tracked at very low cost, and with minimal impact and intrusion on the space objects themselves.

As the device will be designed to operate well beyond the life of the Space object it is fitted to, it will also provide important information to future Space debris mitigation technologies and potentially to Collision Avoidance Manoeuvring mechanisms.

UKLSL have designed the core beacon technology, and WUSAT will design a suitable electrical power supply (EPS) and RF transmission system for monitoring/control. A key feature is expected to be the use of a combined solar panel and transmitting antenna that will form the outside face of the beacon structure.

Andy Bradford (UKLSL Co-Founder and CEO) has been working with WUSAT to develop the concept of WUSAT-4 and its in-orbit test/demonstration of BEAP.

Dr Bill Crofts & Prof Julia Hunter-Anderson, Co-Directors of the WUSAT Programme, www.warwick.ac.uk/cubesat

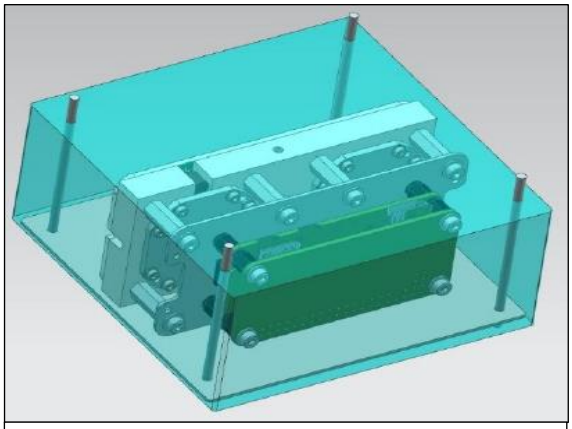
WUSAT-4's research payload is a is a **Space Biology experiment** being carried out by **Dr Tim Etheridge at the University of Exeter**.

The experiment unit is a **Fluorescent Deep Space Petri-Pod (FDSPP)**.

The aims of this experiment are to:

1. Establish miniaturised, remotely operated biology hardware that is compatible with interplanetary missions being planned by ESA and NASA.
2. Provide an option for fluorescent microscopy of model organisms (in vitro and in vivo)
3. Produce experimental hardware that provides enough biomass for molecular analyses and have the ability to photo and video samples in flight and download the data.

The detailed engineering work to design and build the experiment is being undertaken by **John Holt**, a highly experienced Space scientist & engineer at **Space Park Leicester.**



The main body of the FDSPP

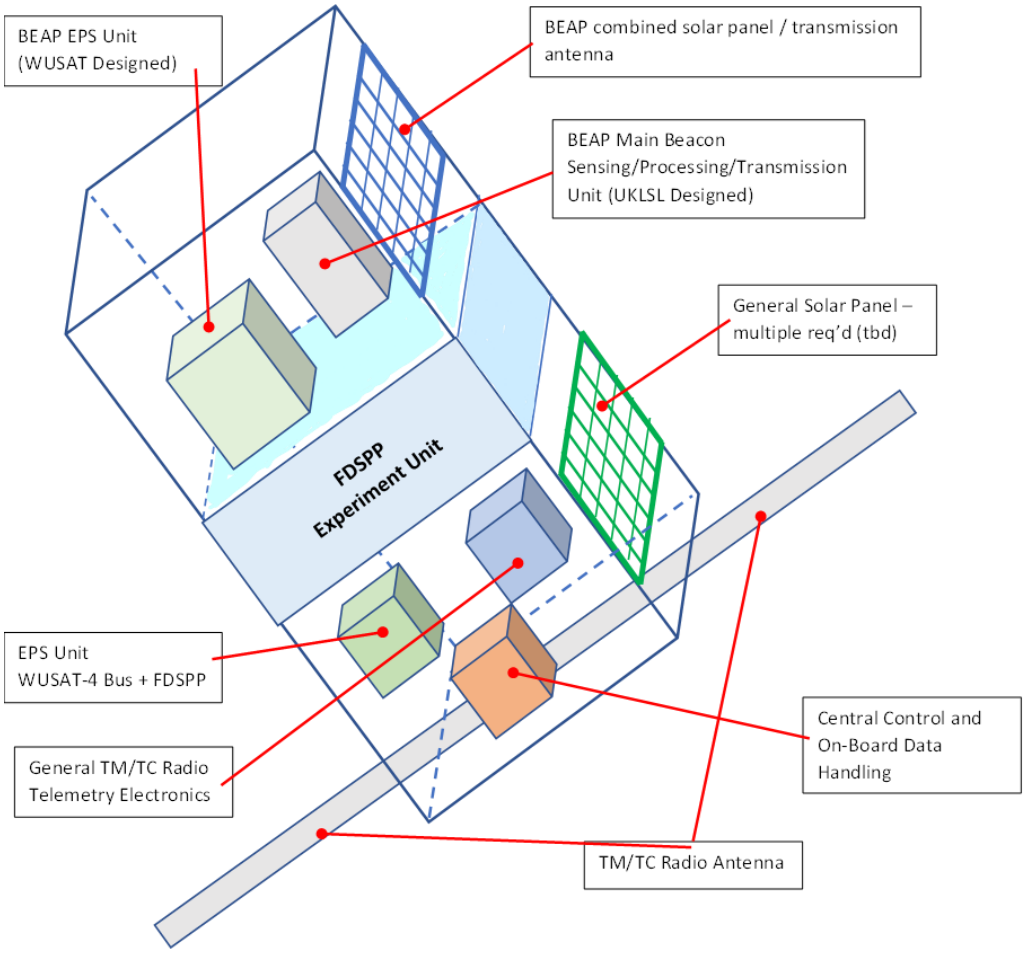
John has already provided the WUSAT team with a detailed data sheet on the FDSPP requirements, and it will be the job of the team to work with John and Tim to successfully integrate the FDSPP experiment and its associated power supply and radio transmission link requirements into the WUSAT-4 satellite.

Further funding is being sought by both research payload partners, and it is hoped that the fact that both partners have received National Space Technology Programme (NSTP) funding for their developmental work to date, will be a motivation for NSTP to further support this joint enterprise.

WUSAT will attempt to minimise potential launch costs if a European Space Agency (ESA) launch can be obtained, but other launch options will naturally incur additional costs.

Overall, we are very excited about the format of this mission with these two payloads and the support of these two partner groups. We at WUSAT believe that the WUSAT-4 mission is a classic example of how the UK's National Space Strategy should be delivered.

An initial, rudimentary configuration diagram of the WUSAT-4 concept is shown below. However, the 2022-23 WUSAT team will produce a mature configuration model based on the detailed requirements and specifications they will identify in their work this coming year.



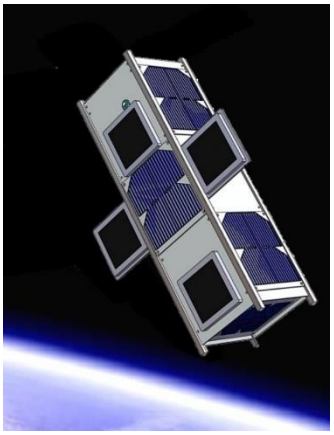
The UKLSL BEAP payload will need to operate as a self-contained device to emulate its eventual role as a transmitter working autonomously on defunct in-orbit Space objects.

Hence its power supply (EPS) will be custom designed to meet the needs of the eventual commercial product as closely as possible.

The concept of a combined solar panel / patch antenna to provide electrical power and the beacon RF transmission in a single until, will also be a key area for WUSAT to investigate.

WUSAT are not expecting to develop subsystems to support the FDSPP payload as such, as this is largely being undertaken by John Holt at Space Park Leicester. However, the WUSAT-4 electrical power supply will be designed to meet the needs of both the WUSAT-4 subsystems and that of FDSPP. The process of integrating FDSPP into WUSAT-4 is also likely to involve some degree of co-development of FDSPP's subsystem requirements.

WUSAT-3 Mission



WUSAT-3, and its ambition to test a novel signal-direction-finding concept with a view to it providing the means of producing smaller, lighter tags for tracking wildlife from Space, has been a huge experience and a massive learning curve for all the WUSAT team that have worked on it.

Sadly, we arrived at the decision that there are currently too many issues that were going to prevent serious progress being made on getting WUSAT-3 to be flight-ready and on an ESA launch. Many of these were outside of the control of WUSAT, but it was felt that it wouldn't be fair to ask another team to spend a year working on it if we didn't feel that a flight-model and launch was currently achievable.

Dr Bill Crofts & Prof Julia Hunter-Anderson, Co-Directors of the WUSAT Programme, www.warwick.ac.uk/cubesat

Space missions are generally complex, and one very big lesson in Space engineering is that the requirements of the payload can make a vast difference to cost, complexity, test requirements and time to launch for any given satellite. All teams that have worked on WUSAT-3 will have understood that fact as part of 'real world' engineering – this is the experience that WUSAT uniquely provides to engineering students.

Thanks once again to the newly graduated 2021-22 WUSAT team who made a valiant effort to get WUSAT-3 on to an ESA launch programme despite the enormous effect of Covid downtime over the past couple of years. It has been a great pleasure to spend time working with you in near normal conditions again, and I was pleased that we could make our trip to Barcelona to keep WUSAT on the ESA map! (See below).

Best wishes to all of you in your new careers. I have no doubt that you will all do very well.

Dr Bill Crofts, Alex Bolland, Mattias Langer, Eduardo Hopkins, Myles Ing,

Jai Bassi, Chiara Biquet, Tahrim Uddin, Prof Julia Hunter-Anderson

We are also extremely indebted to the following who have generously given time and effort to the development of WUSAT-3.

- **Roke Manor Research** – (particularly Jonathan Pearson and Steve Wakelam) for their ideas and support on their signal-direction-finding concept.
- **XCAM** – (particularly CEO, Karen Holland) for much support and assistance with camera hardware and the generous offer of their CD3 flight-proven CubeSat camera system.
- **Lotek** – (particularly MD, Brian Cresswell) who was always very helpful in helping us to identify potential end user requirements that affected design decisions in WUSAT-3.
- **CubeSpace** – (particularly Benoit Chamot, Head of Sales & Marketing) who very kindly received details of the WUSAT-3 model and ran a simulation for us to ascertain the optimum format for a planned Attitude Determination Control System (ADCS).

And of course, to all of our partner companies and associates who contributed in many ways to the experience the WUSAT students received.

We will keep everyone in the loop and know that there are always times when we will need your collaboration again.

ESA Symposium on Space Educational Activities (Barcelona)

It was great to be out and about again after the extended Covid lockdown period, and to be able to take the 2021-22 WUSAT team to the SSEA event in Barcelona (27-29 Apr 2022).

It was very good for me to meet up with many of the guys from the ESA Education Office, in addition to many other UK university representatives involved with Space activities.

The event had a good feel, and the team made a good job of presenting their WUSAT presentation.

It is to our credit that we have always had a presence at every SSEA event, and it gives a great opportunity to showcase WUSAT, the University of Warwick, Midland Innovation Space Group and our many partner companies.

Outreach

Women in Engineering – Supporting the Girls' Day School Trust (GDST) Space Technology Diploma

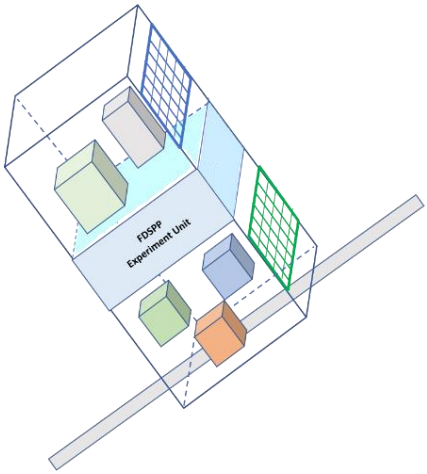
WUSAT are sharing information on their Space missions with Sutton High School's Head of Computer Science, **Nicola Jane Buttigieg**. Nicola has designed and led this Diploma programme, and has listed considerable support from other organisations, including NASA.

Sutton High School is a member of GDST, and the Space Technology Diploma will inspire young women to study STEM subjects and to consider Space technology as a career option.

GDST students who take the Space Technology Diploma will study subjects such as Python coding, stratospheric data analysis, and planetary science. Students on the 2022 pilot year then applied this knowledge to complete projects in Motion Sensor Classification, Replicating Elements of the James Webb MIRI instrument, and using/analysing My NASA Data.

WUSAT will hope to provide inspiration to young female students studying this diploma and to provide 'real world' Space mission scenarios for their project use. Further information can be found at **The GDST Space Technology Diploma - Girls' Day School Trust**

Summary of WUSAT-4 Mission!



WUSAT-4 is a 2-Unit CubeSat that will be designed to meet the requirements of two payloads for in-orbit test/demonstration. The industrial payload for UK Launch Services Ltd will be a beacon transmitter (BEAP) to provide information on the location and orientation/stability of Space objects in orbit. The research payload (FDSPP) will be a Space Biology experiment designed by the University of Exeter and Space Park Leicester to test the engineering concept of running the experiment on future interplanetary missions.

WUSAT will produce a CubeSat to meet the required payload specifications and will specifically work on designs for the BEAP electrical power supply and integrated solar panel/transmitting antenna unit.

Our **partner companies/organisations**

UKLSL

AIRBUS

HARWiN

RS

SPAN
SPACE ACADEMIC NETWORK

AMSAT-UK

EURO CIRCUITS

BLUE-SPACE

Roke
Part of the Chemring Group

XCAM

ESATAN-TMS
thermal modelling suite

Best wishes,

Bill & Julia

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