OSCAR news

AMSAT-UK

Nº 220 - December 2017

RadFXSat (Fox-1B) launches.

The official journal of AMSAT-UK for all users of
Orbital Satellites Carrying Amateur Radio

AMSAT-UK

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Communications For AMSAT-UK, Membership Renewals and the Shop

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THE AMSAT-UK CLUB CALL is G0AUK and the HF Net operates: 3.780MHz +/- QRM Sundays @ 10.00 am local time.– this is often followed by a QSY to 40 metres

Oscar News is usually sent to members 4 times per year (December, March, June & September). Articles and news items for inclusion in future issues will be very welcome. Please email: **ON-editor@amsat.org**

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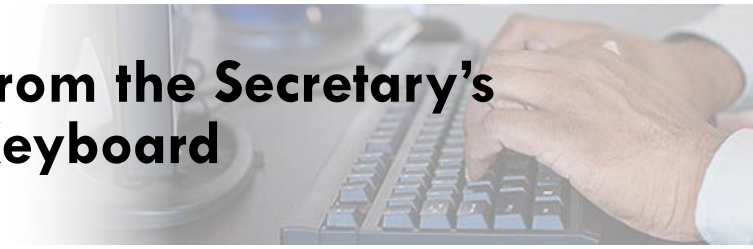
Contents:

Do you have anything for Oscar News?

Please send any news, technical articles or features to: **ON-editor@amsat.org**



From the Secretary's Keyboard

COLLOQUIUM 2017

As many will know the Colloquium this year was held at the RSGB Convention at the Kent Hills Conference Centre in Milton Keynes. Personally I think it was a success. We had a separate dinner at the nearby Hilton Hotel, at which there were about 50 people sitting down. Some of the arrangements for this could be tweaked, but generally the dinner was enjoyed by all. Your committee has had a meeting since the Colloquium which focused on its how things went, and we considered that it went well. There are some small improvements that can be made, eg a ground station would have been appreciated. I think one of the main advantages is our exposure to non satellite amateurs, and we certainly picked up quite a few new members at the event, and in the weeks after it.

Your committee has decided, and the RSGB have agreed, that we should combine next year as well, so I can now give formal notice that the Colloquium 2018 will be held in Milton Keynes over the weekend 13/14 October 2018.

Finally on this topic, may I say a big thank you to all those who helped, either by giving talks, or setting up the lecture theatre etc. Some of you are on the committee, and some are not. Also a big thank you to all who attended. It was great seeing all the usual faces, especially those who took the trouble to travel long distances.

THE AMSAT-UK ON-LINE SHOP.

I am continuing to run this, and business has been good. However there are several items which are now out of stock, mainly because the kind people who volunteer their time to make up kits etc have been busy on other things. I apologise if despatch of orders has been a little

delayed; this is due to my impending move. See below.

Arrow Antennas. I have not restocked these as they are now available in the UK from Moonraker, see **https://www.moonraker.eu/antennas/ham-amateur-radio-antennas#cat=678**

ELK antennas. These have also been out of stock for some time. They are quite bulky, and I will be restocking after I have moved house!

THE MOVE!

It's here at last. As I type this the actual move is about 2 weeks away; the movers are booked and the new house is all but finished! By the time you read this I will probably be ensconced at the new address, which you will find inside the front cover of this issue of Oscar News. After 22 years living in Blandford I have accumulated quite a lot of 'stuff' and the paring down process has been quite difficult, with some ruthless decisions being taken. Suffice it to say I am on my second skip, and I am finding that yesterday's treasure is sometimes today's junk! On the other hand I am saying hello to some old friends which I haven't seen for years! (Including my favourite adjustable spanner!)

I am hoping that, after the move, which is been preoccupying me for many months, I might actually get some satellite operating in!

SEASONS GREETINGS.

Lastly, may I wish the compliments of the season to all our members. I hope you have a very happy time over the holidays, and who knows, we will probably leave FUNcube-1/AO-73 in transponder throughout the holiday for your enjoyment. Watch for a separate announcement on the normal channels!

73s
Jim Heck, G3WGM
Honorary Secretary AMSAT-UK

Home, obviously, is ..
.. Wherever your satellite ground station is!

And from 14 Dec 2017, Jim Heck's will be at

Pickles Orchard
30 Memorial Road
Great Hampden
Buckinghamshire HP16 9RE

Tel: 01494 488232

Formerly of: Badgers, Letton Close, Blandford, Dorset DT11 7SS

2018 MEETINGS & EVENTS CALENDAR

13th January	Heelweg Microwave Meeting, Netherlands
14/15th April	Martlesham Microwave Round Table, Suffolk
21st April	91st RSGB AGM, Birmingham
2nd May	CubeSat Developers Workshop, CalPoly, USA
29-30th May 7th	Interplanetary Cubesat Workshop, Paris
18–20th May	Hamvention, Dayton, USA
1–3rd June	HamRadio, Friedrichshafen, Germany
5-10th Aug	SmallSat Conference – Logan, Utah
17–19th Aug	EME2018, Egmond aan Zee, Netherlands
12-14th Oct	RSGB Convention & AMSAT-UK Colloquium, Milton Keynes

Cubesat Conference and QB50 Workshop

The 9th European CubeSat Conference took place over three days in Ostend in Belgium during the last week in November. It also included the final Workshop for the QB50 Mission and it was these sessions that actually started the event.

The QB50 Mission Workshop

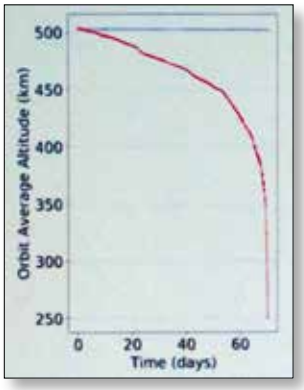
The original QB50 mission was planned for up to 50 CubeSats to be deployed into very low low earth orbit. In the end 28 were deployed in the early summer from the ISS and a further 8 were deployed to 500km on a PSLV a few weeks later. These spacecraft came from universities and research institutes on all five continents and sixteen different countries. It formed the first international collaboration intended to develop a constellation of CubeSats. It involved many hundreds of students and produced more than 10,000 pages of documentation!

The statistics indicate that 9 appeared DoA (Dead on Arrival) but that two of these were "recovered" by using some powerful uplink commanding quite soon after deployment.

All the spacecraft use 70cms downlinks. Some have simplex systems and some have TC uplinks on 2 metres. Almost all are using either 9k6 GMSK or BPSK downlinks and the frequencies were coordinated using 25 or 30 kHz rasters depending on the modulation type. No problems of frequency overlaps or mutual interference have been reported.

The purpose behind the mission was to fly three different types of science sensors through the thermosphere which is presently little understood. Presently all the active spacecraft are still completing their commissioning, including setting up their ADCS - Attitude Determination and Control System, with just one, the South African, nSight-1, already providing initial science data from their FIPEX science payload.

Present indications are that 90% of the ISS deployed CubeSats will deorbit before January 2019 with only those which have achieved a stable ram pointing attitude surviving until late 2020. Obviously, all of those launched on the PSLV to 500 km will remain in orbit for much longer- with one exception.



Inflatesail, a 3 U CubeSat built by Surrey Space Centre, deployed a 10 m2 sail autonomously soon after launch. This was intended as an IOD (In Orbit Demonstration) of a deorbiting device for small spacecraft. It certainly worked – The spacecraft dropped from 505 km to re-entry at 250km after just less than 72 days. It de-orbited over South America at around 01:27 UTC on September 3rd.

All of the teams who made presentations were generous in their praise for the support that they received from interested amateurs around the world. In many cases we gave them their first signal reports and also have also been providing a large number of telemetry updates as well.

The Project Managers of the project VKI – The Von Karmen Institute in Belgium, gave an initial overview of the results and lessons learnt so far:

Management Challenges

- Science can be education but education is not science
- Small does not mean easier
- Management of humans requires a different skillset that just managing technology
- Keep it simple and then try making it even simpler
- Reserve enough budget for in-orbit operations
- Technical Challenges
- The power budget is often overlooked or misunderstood
- Data rates over the radio links are never high enough
- Attitude determination and control is a difficult business
- Redundancy (or the lack of it) must be considered
- The communications subsystem is always critical
- Pre-processing and on-board autonomy are good ideas to be considered.
- Smaller and simpler does not mean that you have to test it less

Many teams then gave reports on their own results, challenges and lessons learnt. What follows is an attempt to capture all of them in a single report:

Project Management

- With the project taking so long there has been a major loss of knowledge about all the systems and staffing is a major challenge.
- Clearly define the roles and responsibilities of each team member.
- Define only one reference system for the design of the satellite.
- Hold regular/weekly meetings with the team and keep up-to-date the documentation on the configuration of the spacecraft.
- Many teams ran out of time to properly develop, test and iterate flight code and relied on being able to upload new software after launch but communications issues prevented that..
- Consider the impact of the import/export laws for your country at the beginning of the project.
- Ensure that the objectives and requirements have achievable targets and that they can provide exact values or conditions. This will help track real progress.
- Insist on full end to end testing including the communication link all the way through the development of the Flight Model.

Technology/Process

- Document all progress in daybook style with additional regular reports and procedure manuals also maintain a vital record of what has actually been built.
- When receiving components and subsystems test them. When assembling a sub-system, test it. When assembling the Cubesat test it. And then well …
- Build a representative Flatsat as soon as possible in the project.
- Make regular end to end tests with the EGSE (Electrical Ground Segment Equipment) remote from the spacecraft. Try to use this for all testing.

- To check the radios properly move the ground radio outside of the cleanroom – maybe to the other side of the campus. Test with weak signals to simulate the path loss in space. Have lots of attenuators to hand.
- Don't radiate full power from the transmitter into antennas when inside the thermal vacuum test chamber. The reflected power may be sufficient to damage your transmitter.
- Always include an umbilical connector to the OBC that remains accessible AFTER the CubeSat is fully integrated.
- Flight software development and implementation is a perfect example of the 80/20 rule.
- Many iterations of flight code will be needed to ensure that operations mode changes and anomaly handling are correctly carried out.
- Always implement a way to reset the counters on the spacecraft.
- Assume nothing – do not believe the spec sheets – test test and test
- If it looks good then don't believe the power budget without proper review…it will look not so good when more payloads come on – take a pessimistic view to start with.
- 60% of the failures during integration with the deployer are caused by CubeSats having dimensions that are outside the agreed specifications.
- Always have an Engineering Model/Flatsat available for comparison testing after launch

Space Segment

- Spacecraft failed to properly deploy all the antennas due to a negative power budget and low battery level or an errant EPS watchdog. Having an engineering model/flatsat still in the lab enabled the situation to be replicated. Problem solved by commands sent using a a 25 metre dish!
- Spacecraft worked fine in space for 90 days – now just beacons with no data. I2C problem suspected.
- Check physical tolerances. Is the CubeSat properly assembled or has become a trapezoid?
- Check electrical tolerances..one payload reported to not to function correctly if the 3.3v rail is actually above 3.32v
- Robust error handling required.
- Provide every conceivable command in the software
- If the skills and flight hardware exist then an initial bootloader start-up code followed by flight code that can be patched from the ground should be considered – but only if the skills and link budget will permit.
- If uploading new flight code ensure that the system reports which packets have been received not just how many!
- Some other subsystems can be effected by the on-board radio transmissions – for instance magnetometers.
- Standard terrestrial GPS systems do NOT work in space without special code.
- Magnetorquers may not have enough torque to provide attitude control below 400km
- Residual magnetic dipoles in CubeSats can generate unwanted moments in orbit
- Long wires to solar panels can also generate unwanted dynamic magnetic moments.
- Magnetometer readings are temperature dependent.
- PC104 connectors on a 3U CubeSat with I2C is a seriously bad combination- cross talk, voltage drops and noise etc. Overall an emc/emi nightmare.
- Mounting the SD card proved difficult some weeks after launch – have a backup plan.
- Don't have the battery heater command enabled without a "Are you sure" check box.

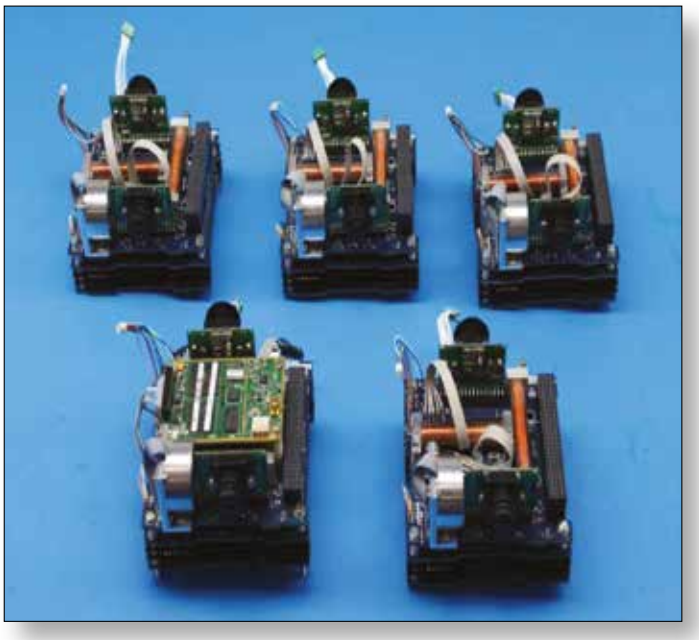
- A free running, on-board clock can often drift over long periods of time. This may not be noticed during short duration tests in the lab and may also be temperature dependant. One team reported 154 seconds drift over a 4 week period.
- Consider including a watchdog to reboot the entire spacecraft if no command is received from the ground within "x" days.
- Most of the causes for CubeSats failing to reach their objectives originate in poor ground testing, unreliable link margins and poor ADCS design

Communications

- Always make friends with friendly amateur community – they are the experts about almost all things radio.
- Commanding is more difficult than reception
- Rapidly spinning or tumbling spacecraft can be hard to communicate with. Allow for this possible fault condition
- Satellites move quickly
- It is good to have robust positive confirmation of antenna or boom deployment -this can often be uncertain in space.

Ground segment

- Commanding not reliable – traced to antenna calibration errors, intermittent failures of antenna and rotation harnesses. Also found that masthead preamp was not switching over to TX quickly enough to transmit the first parts of the commands.
- Lack of experience tracking spacecraft and running the required software in unattended mode caused many headaches after launch.
- Have plenty of spare parts available on site.. RF cables, connectors etc etc
- Set-up of the ground station was more challenging than expected.
- Experience comes with practice (and frustration)



- ***Some of the 15 ACDS systems produced for QB50 by Stellenbosch University and the Surrey Space Centre***

The CubeSat Symposium

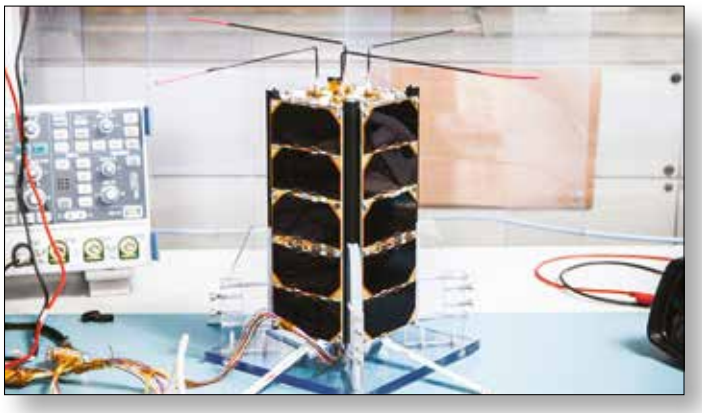
The main Symposium followed on from the QB50 event and covered a wide range of subjects including many future sophisticated science missions.

It is fair to report that there were many illustrations of new spacecraft which, although planning high speed data downlinks on the non-amateur S and X bands, also included VHF and/or UHF deployable whips.

It is worth noting that, as well many new CubeSats being developed, we are also seeing plans for dedicated launch systems for such payloads. There was a presentation from the Swedish Space Center at Kiruna of their plans to develop spaceport to launch payloads up to 150kg.

This has to be seen in context with the upcoming second test flight of a similar vehicle called Electron from New Zealand. Additionally, the UK government's has plans for possibly two spaceports in the UK. Virgin Orbital are developing their air launch vehicle from using a re-purposed 747-400 from the Mojave Desert and there is a similar project with a converted

MD11 aircraft from Orbital Access who are planning to operate from Newquay Airport. Finally, at a recent space conference in London, details were given about a rocket based launcher programme called Orbex. This is apparently being developed in Scotland and may lift of from Sutherland, perhaps as early as next year. Exciting times ahead.



Finland's Aalto-2 in the lab before launch

SpaceUK Magazine

For those readers who cannot get enough information about space then can we suggest that you subscribe to the regular Space-UK magazine that is published on behalf of the UK Space Agency?

The latest, interactive, edition is #48 and the issue includes features on the space emergency service, a mission to remove space debris, and a celebration of the Cassini Huygens mission. It can be downloaded from **https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/660162/spaceuk_issue48.pdf** You can subscribe for future editions and also download previous editions from here: **https://www.gov.uk/government/collections/spaceuk-the-space-sector-magazine**

Articles for Oscar News

Your news, views and articles for Oscar News are always very welcome.

The magazine is intended to provide interesting details about our various space missions and the groundstations needed to communicate with them. The editors are happy to accept them in almost any of the usual formats but please keep the images separate or put them at the end of the document.

We are also happy to do any proof reading needed! Please contact us with your information or if you have any questions.

Many thanks in advance for your contributions.
editors@amsat-uk.org

The Deep Space Gateway – aka the "DSG"

As we know, some parts of the International Space Station have been in space for more than twenty years and even the Columbus module has been up there for ten years. To say that its days are numbered is probably a little bit premature but currently it is expected that its present role and activities will cease sometime in the 2024-2030 time frame.

In the past few months quite a lot has been heard about the DEEP SPACE GATEWAY so we should get used to learning a new three letter acronym the "DSG" perhaps to replace the "ISS"!

The current information available on the ESA website includes this background:
The Deep Space Gateway is being established as a strategic platform, from which human exploration of the Solar System can set forth. Its location in the lunar vicinity, and outside of the Earth's deep gravity well allow it to be used as a staging post for exploration missions to the lunar surface and eventually to other deep space destinations including Mars. It is also a platform in a location where the human and technological challenges of long duration human missions in deep space can be investigated and addressed. The platform is being prepared through international cooperation, led by the partner agencies of the International Space Station: ESA, NASA, JAXA and CSA.

The technical definition of the Deep Space Gateway is driven by the technical needs of preparing deep space human exploration. It could also support opportunistic scientific research. This research could relate to a wide range of scientific disciplines. Investigations related to these various research areas will carry with them specific technical implications for the Deep Space Gateway.

It is understood that a decision has recently been taken by the existing ISS partners to assemble and operate the proposed cis-lunar station in a so-called Near-Rectilinear Halo Orbit, or NRHO. This giant, egg-shaped loop extends 70,000 kilometers from the Moon at its farthest point and comes as close as 1,500 kilometers at the nearest. An NHRO would enable the station to save propellant for orbital corrections and avoids the blocking of sunlight by the Moon from reaching the station's solar panels, while always keeping the spacecraft within a line of sight to ground controllers on Earth.

A call for proposals was recently issued by ESA to cover ideas for educational utilisation of the spacecraft during its life. They actually gave a very short time to get the responses back and so a number of ARISS and AMSAT teams met during a breakout meeting during the Colloquium to have a brainstorming session for ideas. As a result of the meeting, four fully detailed ideas were created and sent off to them by Oliver Amend DG6BCE, who is the Chair of ARISS-EU, in time for their deadline.

What is reproduced here is a compilation of those documents. The ESA headings and questions are shown in blue type!

Call for Ideas for educational utilisation of the proposed Deep Space Gateway.

About you

Your Name	Oliver Amend
Your affiliation	ARISS International Team via the International Consortium of AMSAT Organizations
About you	Other Educational Professionals
Email	oliver.amend@gmx.de

Your idea: Remember your idea does not have to include physical hardware (e.g. could be use of existing data, or ground based activity somehow utilising the DSG) and should be

light on resources (especially crew time). DSG will be designed with primary objectives of Human Space flight, educational and research adaptations shall therefore make minimal impact on the primary objectives.

Which scientific area(s)/environment(s) are of interest?

o Lunar surface science using tele-presence

o Collecting and returning planetary material

X Understanding the effects of deep space radiation and/or fractional gravity

X Observation post for monitoring Earth's climate

o A platform for astronomical observations

o Fundamental physics

X Heliophysics

X Additional opportunity during the cruise phase (see **http://exploration.esa.int/moon/59375-opportunities**)

X Other

Other unique area of investigation/ environment(s)

Educational experiments that leverage the amateur radio equipment on-board the deep space gateway. These can include live contacts with the crew, space communication experimentation, and a wide variety of on-board student experiments that can employ the amateur radio system for commanding and downlink telemetry.

A description of your idea:

Since the dawn of space travel, amateur (ham) radio has been a constant companion as the international space agencies explore our Earth and the solar system. Through these partnerships, hams pioneered the first home-built satellite (OSCAR-1, 1961), invented CubeSats, and deployed the first ISS satellites (SuitSat, ARISSat). We tested GNSS reception above the GNSS constellations, fundamentally changing space navigation sensing. And we have inspired and educated countless students, hams and the general public to pursue science, technology, engineering and math (STEM) careers. These accomplishments were performed collaboratively by an international consortium of AMSAT (Radio Amateur Satellite Corporation) organizations with our human spaceflight initiatives accomplished through our ARISS team.

Our idea is to develop a ham communications capability for the Deep Space Gateway (DSG). Leveraging our ARISS knowledge and team, we would maintain and operate this ham station and work with schools to inspire, engage and educate students through interactions with DSG crew members, when available, and interactive educational projects and experiments that can be directly commanded and data downlinked through our amateur radio system.

Expanding on the DVB technologies currently employed in the ARISS HamTV system, we will provide direct access to ham radio telemetry and data for educational outreach. Our station would include two-way DVB communications and employ amateur microwave frequencies (e.g. S-Band, C-Band, X-Band) with DSG-mounted external antennas. Very simple ground station equipment will be required with the opportunity for students to build the ground antennas. Student developed experiments could also be interfaced to the DSG ham station, enabling interactive command uplinks and data downlinks. The data collected would be stored in an internet-based Data Warehouse and made freely available for later use and review by students around the world, similar to our approach on our FUNcube CubeSat. When there is a DSG crew on-board, we can hold interview sessions with schools and astronauts similar to ARISS contacts. However, the sessions can be expanded to include 2-way video and not be constrained by short (10 minute) pass times. Through a plethora of communications modes (voice, image, TV, data) numerous interactive activities can be devised to engage students in a stimulating manner. If a UHF receiver is

embedded in the DSG station, the transponder could support CubeSat-deployed relays using the Proximity-1 protocol. Finally, similar to ISS, Mir and Shuttle, our station can also support independent backup communications capability if issues arise with the DSG prime communications capability.

Also: For Undergraduate, Postgraduate and Individual Lifelong Learning – but not limited to them- the following project examples could be presented:

The amateur radio platform on the DSG could be used/repurposed for advanced experimentation. We would expect Universities, students and individuals to propose novel investigations which may include a significant use of the electronic and computing capabilities of the installed DSG hardware allowing them to prove and/or test concepts on earth prior to carrying out the experiments in deep space. This could include/require international collaboration on the experiments and/or processing of the data.

For example: Our ARISS/AMSAT team would like to see Universities assess the use of the Global Navigation Satellite System in the Deep Space domain. This would reprise the experiments that were carried out in 2001/2002 on the High Earth Orbit AMSAT-OSCAR 40 satellite.

AMSAT and ARISS amateur radio enthusiasts are volunteers and have achieved several notable "space firsts". For details please refer to **www.ariss-eu.org** and **www.amsat-dl.org**.

The deep space environment provides a new place to investigate applications in communications, navigation and timing, thermal effects, ionising dose and single event radiation effects.

Also: For Primary/Elementary School Students – but not limited to them- the following project examples could be presented:

Transmission and reception of pictures from space. This could include earth observation should the amateur communications capability also include any earth/moon facing cameras of the DSG or as part of the DSG amateur radio system equipment.

These pictures could be parts of a much bigger picture that the students have to receive and assemble over time or partner with international schools to obtain pictures that are only transmitted from the DSG when specific regions of the earth are visible.

Creating competitions for this age group that allow their imagination and creativity to be exposed but accepting that more advanced help will be required to proceed to implementation.

Live contacts with crew members on board the DSG where the students can quiz them about life in deep space and space exploration.

Where the idea comes from:

Amateur radio operators and the various international AMSAT organizations have a rich history of pioneering achievements for human spaceflight (examples: SAREX, ARISS), low earth orbit (example: educational outreach using the mini constellation of FUNcube based spacecraft), high earth orbit (examples: GPS experiment and radiation belt detection on OSCAR-40 in 2000) and deep space (examples: Venus radar, Voyager-1 reception, ISEE-3 reboot project). Given our outstanding relationship with the international space agencies and with schools and universities, the amateur radio community could serve as an ambassador for space activities at the educational level (primary school up to universities.

Which Institutions/individuals do you believe would be interested in this idea? Either specifically or in general.

Once the on-board amateur radio system is installed in the DSG, it can be exploited

by many, diverse institutions around the world, including primary-elementary schools, secondary-high schools, universities (undergraduate students and above), amateur radio operators and the international space agencies.

How could your idea be utilised by several Universities, either one at a time or at the same time? Think about re-usability and adaptability over the mission lifetime.

The radio system will be developed to support numerous communications modes, including 2-way voice, image, TV, & data. Similar to what ARISS has accomplished for previous educational activities (e.g. ARISSat) simple experiment interfaces will be provided to link a university experiment to the amateur radio communications system. This will allow the university to directly interface with their experiment from the ground. In addition, there are a number of student amateur radio groups in universities and colleges around the world that could support various experiment initiatives as ground stations to gather the experiment data or to enable students to talk to the DSG crew when they are on-board.

We plan to use a software defined radio (SDR) as part of the ham radio system. ARISS flew an SDR on the hand-deployed ARISSat satellite. With this system, universities could participate in a 'fly-your-code' competition to try new communications ideas and techniques. These SDR algorithms would be preselected and tested on the ground before uploaded via amateur radio uplink into the transponder to serve different projects and experiments.

Do you believe your idea is also suitable for high school students? Or could be adapted to be suitable? If so, how?

The proposed amateur radio capability supports high school and younger, primary school students, by allowing them to engage with the astronauts while on-board. High school students can also utilize the ham radio equipment for various immersive or interactive communications ideas, such as downloading image "puzzles" that they need to solve, developing and performing simple experiments on solar system radiation, time of flight (speed of light) measurement experiments, studies in Earth's climate monitoring or collaborating with a university on their experiment. In this later scenario, university students would work with and mentor high school students on either the high school or the college experiments to springboard the high school students in new areas of science and engineering.

If you have a specific example of your idea, please describe it here (optional)

AMSAT and ARISS amateur radio enthusiasts have achieved several notable "space firsts". For details refer to **www.ariss-eu.org** and **www.amsat-dl.org**.

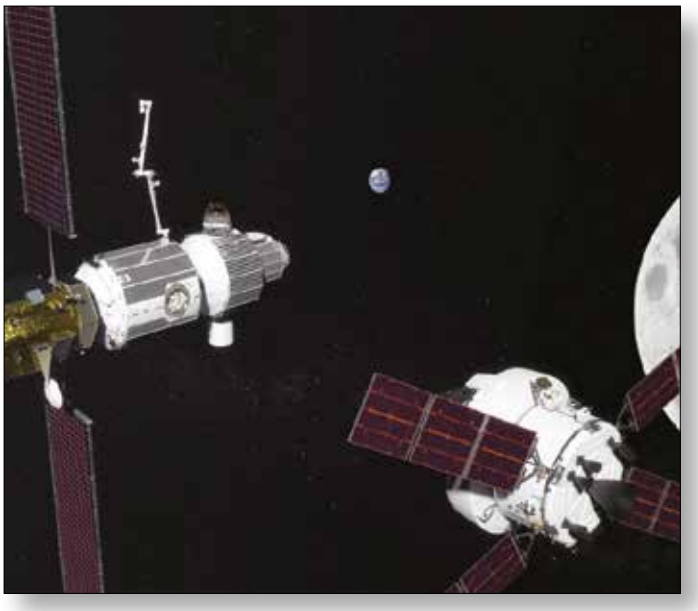
Specific examples of experiments and activities for primary, secondary (High School) and university students are provided in separate "Call for Ideas" inputs from ARISS & the international consortium of AMSAT organizations.

Basic estimates of any technical requirements/constraints on the Deep Space Gateway (OPTIONAL)

- Upload Mass 5-10 kg
- Download Mass 0 kg
- Electrical Power requirements
  50W max, 10W average
- Data rate (to Earth) 0 (not dependent on NASA/ESA ground stations—we provide & maintain our own communications)
- Mission duration 100% of DSG lifetime
- Crew operations/crew time
  0 (except for crew school contacts)
- Access to crew habitat
  Yes requires a small amount of space

- Direct access to crew (e.g. physiology experiment) Yes only during school contacts; ARISS has shown these are big psychological boosters for the crew
- Exposure to deep space Yes - Antennas only
- Moon pointing No
- Earth pointing Yes
- Dark sky pointing No
- Other (please detail below) Yes

Equipment requires only small amount of space in DSG cabin. Crew time only required for direct organized crew-school contacts. No separate downlink data rate required, as not dependent on NASA/ESA ground stations—we provide & maintain our own communications.



- ***Image Credit: NASA***

KA3HDO receives Honour at the Colloquium

ARISS International Chair Frank Bauer, KA3HDO, has been honoured with the Ron Broadbent, G3AAJ, Trophy. The presentation came during the AMSAT-UK International Space Colloquium in October.

"AMSAT-UK totally shocked me yesterday at the colloquium with the Ron Broadbent Trophy," Bauer reacted. *"I was nearly speechless when asked to come up and receive the trophy for ARISS work. I mentioned that, early on, Ron was a phenomenal supporter and contributor to ARISS, with his sage advice and guidance."*

The G3AAJ trophy is awarded annually by AMSAT-UK to an individual or group for outstanding service to the Amateur Satellite service. The trophy was donated to AMSAT-UK by the late Ron Broadbent, G3AAJ.

ARISS received the G3AAJ trophy last year in recognition of the ARISS UK team's dedication in working with the UK Space Agency to facilitate the Principia Mission of astronaut Tim Peake, KG5BVI, aimed at engaging students in 10 UK schools in science, technology, engineering, and mathematics (STEM) subjects.

Satellite Regulation – An Introduction for New Entrants.

Jim Heck - G3WGM

A study day with the same title as above was held in London on 3 Nov at the offices of Ofcom. It was jointly hosted by Ofcom and the UK Space Agency (UKSA). It was open at no charge to the public in general, and I decided to attend as a representative of AMSAT-UK and radio amateurs generally. There were about 70 others there from various organisations, including several start-up companies. Also in attendance was AMSAT-UK committee member Chris Bridges, from SSC.

I don't intend to give a blow by blow account of what was said, but will pick out a few salient points, and give a flavour of how the day went.

The main topics (apart from the introduction) covered were:

- Overview of Satellite Regulation
- Spectrum –How to make a satellite filing in the UK
- Spectrum –How to license an earth station in the UK
- UK Outer Space Act licensing

Overview of Satellite Regulation.

The main point made in this section was that regulation was necessary to limit the chance of damage either by physical collision or by radio interference. The need for regulation was perceived internationally, and was conducted under the auspices of the ITU and its regulations. The UK has several treaties which put it under a legal obligation to perform regulations on its satellites.

- The ITU regulations are updated at every World Radio Conference (WRC)
- The ITU has been considering the requirements for small satellites since 2012.

Spectrum –How to make a satellite filing.

This is the process of informing the ITU of the details a satellite intended to be launched into orbit. The filing is made through Ofcom in the case of UK satellites. Even if the satellite will operate in the Amateur Satellite Service, filing is required. The filing contains details of the proposed satellite in terms of radio frequencies, types of emissions, (on uplinks and downlinks), type of orbit, position of orbit. Once the filing has been accepted by the ITU, then they will ensure that none of the 193 member states have any objections. It was suggested that the process of defining and submitting the filing to Ofcom might take at least two months, and that after submission to the ITU a further period of between 9 months and 7 years is required to complete the filing. It is hardly surprising that the number of filings in the UK is rising steadily. In 2016 there were approximately 300, and in 2014 approx 220. Currently OFCOM makes no charge for it services in registering a filing, but the ITU will recover their costs which might be between 570 and 7030 Swiss Francs

Spectrum –How to license an earth station.

This section wasn't very relevant to us, as our ground stations operate in the Amateur Satellite Service, and are hence already licenced. But it was interesting to note that for Receiving signals from satellites, no licence is required. So things like GPS receivers, satellite phones etc do not require a licence.

Outer Space Act licensing.

This presentation was made by Richard Crowther, Chief Engineer at the UK Space Agency. It is the Agency's responsibility to ensure that UK registered satellites conform to the requirements of the UK Outer Space Act. This Act ensures that UK satellites conform to the various international treaties that the UK Government have signed. One of their biggest considerations is the risk associated with the satellite being in orbit (third party liability insurance) and also the risk of third party liability during the launch. In recent years more consideration has been paid to small satellites, including Cubesats). The existing UK Outer Space Act will be amended by the eventual introduction of the Space Industry Act which is presently a Bill going through parliamentary process. It is unclear when these amendments might become effective.

Richard introduced the traffic light concept of initially establishing the risk of satellite launch and operation. In summary

- RED. LEO satellite injected into orbit with a projected deorbit time much greater than 25 years
- AMBER LEO satellite injected into an orbit with greater than 25 years life, but with a deorbit system
- GREEN. LEO satellite into an orbit with less than a 25 year life time

Whereas at present the amount of third party indemnity is required to be £60M, this will change to a variable amount when the amendments to the UK Outer Space Act become effective. The amount of insurance required will depend on the calculated risk.

Richard showed some very interesting graphs, showing factors that affect risk. Eg one showing collision probability indicated that the highest risk was at an orbital height of 780 km, and at an inclination of approx 90 degrees. The risk was much lower at heights below 400km and more than 1800 km. At low risk (GREEN) were satellites that were ejected from a dispenser on the ISS, and which conformed to the CubeSat standard where the resultant orbit would have a very short life time of only a few months.

SUMMARY.

- I got the distinct impression that Ofcom and the UKSA have, over the last few years, come to terms with the requirements for small satellites.
- Throughout the day it was stressed "Come and talk to us EARLY in your project".
- The forthcoming amendments to the UK Outer Space Act will have significant changes to how the system of regulation is administered, particularly licencing, which could become cheaper. But watch this space!
- All the slides presented at the meeting can be downloaded from here **https://www.ofcom.org.uk/__data/assets/pdf_file/0025/107557/Satellite-regulation-teach-in-event.pdf**

FUNcube Mission Update.

The great news is that AO73/FUNcube-1 recently celebrated its fourth birthday in space!

As reported on our website. *"FUNcube-1 was launched at 07:10 UTC on November 21st 2013 and its first signals were received immediately after deployment over the Indian Ocean by amateurs in South Africa. Since then it has been operating continuously in either its education mode or, with the transponder active, in amateur mode when in eclipse and at weekends.*

The spacecraft has spent the four years in space orbiting the earth at between 640 and 580 km and has now travelled around the earth more than 20,000 times. That represents a distance travelled of approaching 500 million miles.

Up to now, each of the orbits has been spilt approximately 65% in sunlight and 35% in eclipse. This has resulted in the temperatures inside the small spacecraft varying by about 25° C during each orbit.

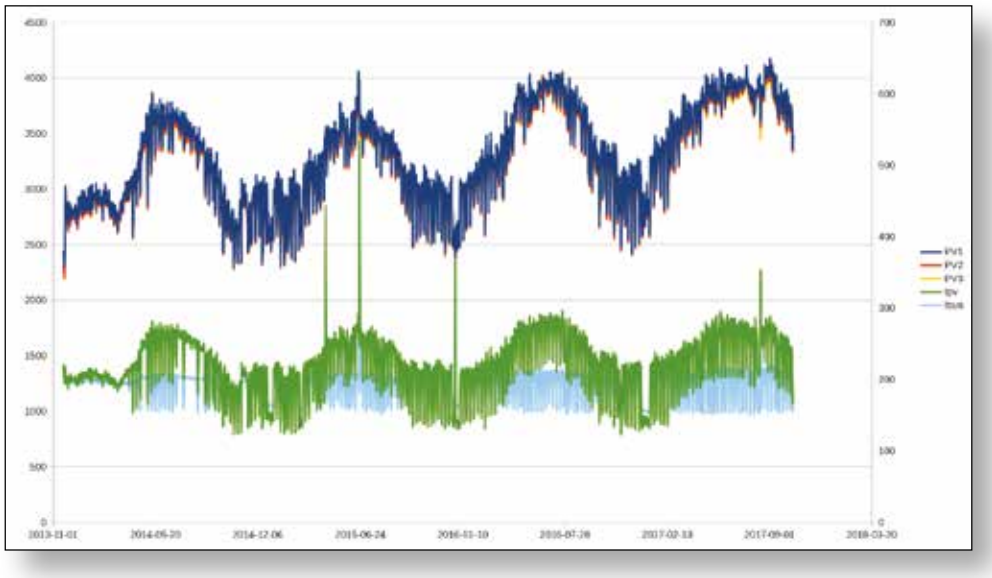
At the recent AMSAT Colloquium, Wouter, PA3WEG, during his presentation about the FUNcube project, mentioned that the power available from the solar panels has been slowly increasing since launch. This observation led the team to do some further investigations as to the cause.

Although the launch was into a nominally Sun Synchronous orbit, over time this has drifted and the spacecraft is now entering a period when it will be in the sun for longer periods during each orbit.

The exact details are still being determined, but it seems likely that, starting from January 2018, there will be periods when the spacecraft will be in the sun for all, or almost all, of its orbits. Of course, this means that the on-board temperatures will be much higher than we have previously experienced in flight, although we have some test records from pre-flight thermal air testing that were undertaken after integration.

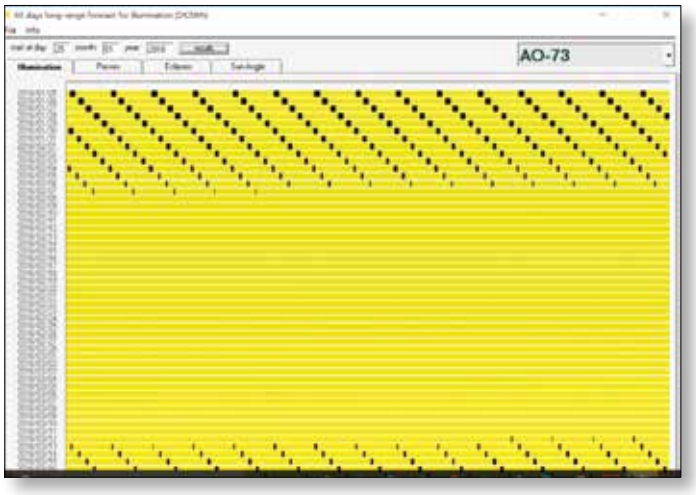
The key will be to discover what the equilibrium temperature will be internally. For comparison, AO85 has already "enjoyed" periods of full sun and its internal temperatures have reached up to around 55° C.

So the next few months will be quite an exciting time for the team! We remain extremely grateful to everyone is using the spacecraft for both its educational and amateur missions. Of course we are also very, very grateful to those who are downloading the telemetry and uploading the data to the Data Warehouse. It continues to provide a unique record of "life on board" a 1U CubeSat in space."

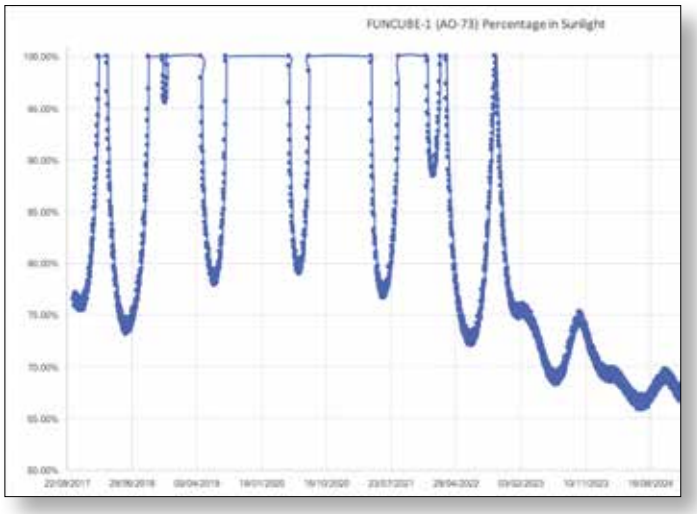


To further celebrate AO73's birthday Wouter, PA3WEG, released this composite video showing all the FUNcube launch events **http://bit.ly/2i5POt6**

We have now had the opportunity to undertake some further research and analysis of these forthcoming barbeque periods. Here are two graphical interpretations, one short term and one long term. The first illustration uses Mike, DK3WN's illum.exe software and shows that AO73 will start to experience increasingly long periods of full sunlight from mid January next year. It is then predicted to enter a period of full continuous sun on February 7th until March 12th.



The following chart, kindly produced by Chris, M0IEB, shows a rather longer period of time and indicates that, after the spring, we will be entering a series of long periods of full sun. These appear to be about nine months in duration and to continue for some four years.



Whilst we were launched into the correct "gentle" orbit that we expected, it is now obviously changing and will give us some considerable thermal challenges over the upcoming years.

It is interesting to compare the length of our sunlit periods with the other two CubeSats that were deployed at the same time and from the same ISIPOD deployer. The first one out was HinCube, then AO73 and with ZACube-1 last out. The lightest spacecraft are always on top, first out and the one with the greatest mass is at the bottom.

As this article is being written at the of November, these are the current perigee and apogee details for the three spacecraft:

- AO73/FUNcube-1 582 x 666 km
- ZACube-1 584 x 669 km
- HinCube 590 x 673 km

Illum.exe suggests that the sunlight periods for the other two will be significantly greater than the predictions for AO73. It is amazing how much difference a few kilometres is making in this situation.

It is not yet known what the best strategy will be to ensure the safe survival of the spacecraft during these full sun periods. It may become necessary to operate in safe mode. This would be a low power telemetry downlink only. We will see what happens!

Meanwhile although EO79 is presently not in service, both FUNcube 2 on UKube-1 and EO88/Nayif-1 continue to operate nominally.

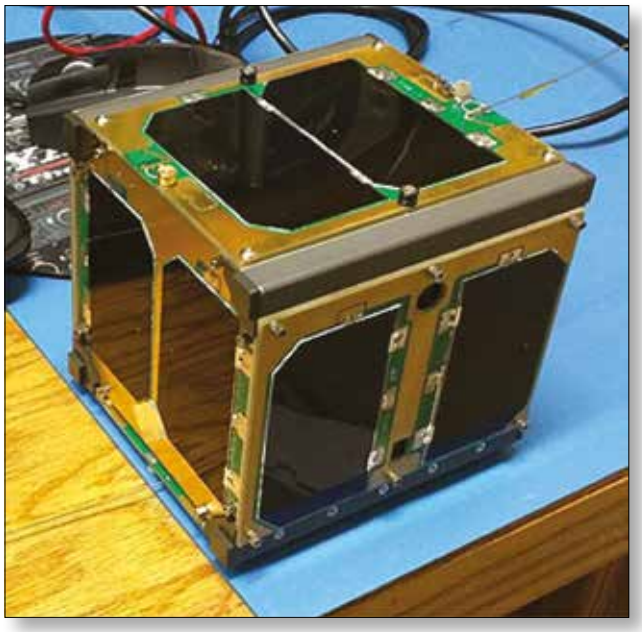
RadFxSat (Fox-1B) Launched

The Delta II rocket carrying RadFxSat (Fox-1B) launched at 09:47:36 UTC on November 18, 2017 from Vandenberg Air Force Base, California.

Following a picture-perfect launch, RadFxSat was deployed at 11:09 UTC. Then the wait began. At 12:12 UTC, the AMSAT Engineering team, watching ZR6AIC's WebSDR waterfall, saw the characteristic "Fox Tail" of the Fox-1 series FM transmitter, confirming that the satellite was alive and transmitting over South Africa. Shortly after 12:34 UTC, the first telemetry was received and uploaded to AMSAT servers by Maurizio Balducci, IV3RYQ, in Cervignano del Friuli, Italy. Initial telemetry confirmed that the satellite was healthy.

After confirmation of signal reception, OSCAR Number Administrator Bill Tynan, W3XO, sent an email to the AMSAT Board of Directors designating the satellite AMSAT-OSCAR 91 (AO-91).

The commissioning of the spacecraft has now been completed and it is now open for user access.



Name(s): AO-91 Fox-1B (RadFxSat)
NASA catalog number: TBD
NASA ElaNa XIV Mission
JPSS-1 Delta II, Vandenberg AFB, CA
Orbit: LEO (Low Earth Orbit)
Inclination:
97.6908 (Assuming it is Object 43016)
Eccentricity:
0259769 (Assuming it is Object 43016)
Period: Approx. 95 minutes
Estimated orbital lifetime: 5+ years
Size: 10 x 10 x 10 cm (4 inch cube)
Weight: 1.3 kg (~3 pounds)
Transmit power: 400 mW (Minimum)
Downlink: 145.960 MHz FM voice
AFSK digital data up to 9600 bps
Uplink: 435.250 MHz FM voice
(67.0 Hz CTCSS tone)

From a communications standpoint Fox-1B has two major changes from AO-85. First, it will fly with a more sophisticated power control system which utilizes a Maximum Power Point Tracker to insure optimum charging of the batteries under all illuminations. This will be largely transparent to the typical user but will significantly increase the available battery life. Second, the detection of the 67.0 Hz tone has been enhanced, which will also help accommodate ground stations whose CTCSS tones may be slightly off frequency. The combination will make accessing the satellite easier and also decrease the likelihood of dropouts.

Doppler Shift Correction for Fox-1B

If you are not using software to track the doppler on your radio then manually correcting for Doppler shift will involve the same techniques as for AO-85, with slightly different frequencies to prevent mutual spacecraft interference:

(See chart overleaf - Ed)

Receive Frequency	Transmit Frequency (67.0 Hz Tone)	Satellite Position
145.960 MHz	435.240 MHz (Mem #1)	AOS
145.960 MHz	435.245 MHz (Mem #2)	Approaching
145.960 MHz	435.250 MHz (Mem #3)	Passing
145.960 MHz	435.255 MHz (Mem #4)	Departing
145.960 MHz	435.260 MHz (Mem #5)	LOS

Note that the AFC on the receiver may be working hinting that making the above adjustments may not be necessary. AMSAT VP of Engineering Jerry Buxton N0JY states *"... in ground testing with Fox-1A. We could be +/- 10 kHz and not even know it (that's how it was tested, one guy programmed the wrong frequency in his HT)."* He adds the caveat, *"One station on the uplink is not the same situation as real life though."*

Fox-1B Telemetry

Subaudible Telemetry

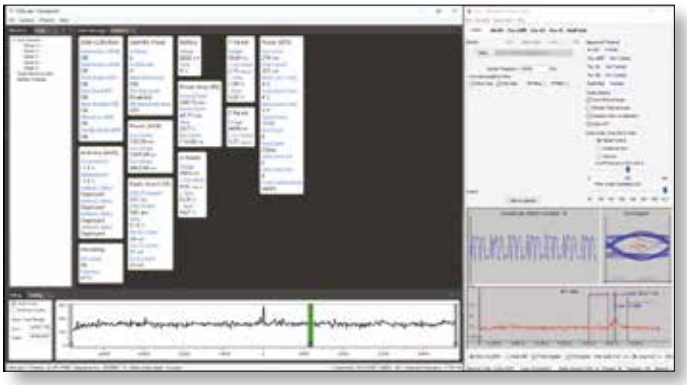
Except for a different downlink frequency, the low speed subaudible telemetry will be the same as for AO-85. It will be supported by the same FoxTelem software released for AO-85.

High Speed AFSK telemetry

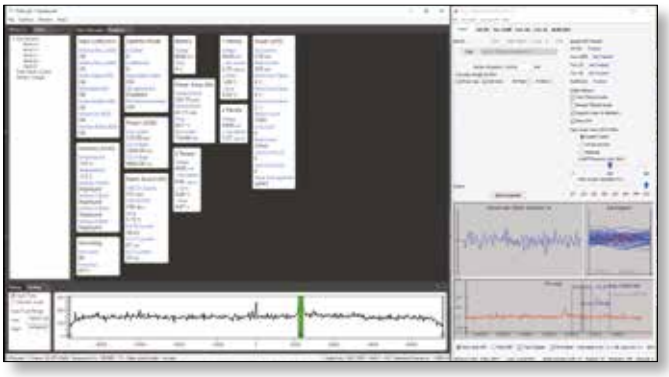
There are no experiments on Fox-1B which will require the use of high speed telemetry.

Generally there have not been many details of the inner workings of the Fox spacecraft released so it really good to see that there is a full description of the new MPPT (Maximum Power Point Tracking) system on the Hackday website. **https://hackaday.com/2017/11/27/amsat-mppt-goes-to-infinity-and-beyond/** This is designed to ensure the best possible efficiency of the electrical power system. There is a really detailed description of the sub-system here **https://github.com/FaradayRF/Fox-1-MPPT/blob/master/Documents/Fox-1_MaximumPowerPointTracker.pdf**

It is worth noting that unattended stations can easily monitor the telemetry coming from both the FUNcube spacecraft, AO73 and EO88, and that coming from Fox 1A & 1B, AO85/91, using a FUNcube Dongle. It is entirely possible to run the FoxTelem software, which works with both Fox spacecraft, and the individual FC1/AO73 and Nayif/EO88 Dashboards at the same time with a single Dongle. The FoxTelem sets the centre frequency of the Dongle at 145.930 MHz and this seems to work fine for all of the spacecraft! Simply start the FoxTelem programme and then the FUNcube dashboards. For the FUNcube Dashboards just select the "Capture from Soundcard" option.



Receiving telemetry from Fox1A AO85



Receiving telemetry from FUNcube-1 AO73

AO91 (Part 2) - An Introduction

John Brier KG4AKV

AO-91 is an FM repeater [1] satellite with a strong 2 meter downlink (receivable with a rubber duck) and an incredibly sensitive receive system on the 70 cm uplink. There are reports of people getting into the bird using a handheld inside a house. That is incredible. This will likely become another "Easy Sat" like AO-51 was.

For years, the only FM bird was SO-50. It has a great receiver but the downlink is not strong (only 250 mW), so it isn't easy for beginners to use. AO-85 is another FM satellite that was launched a couple years ago. It has a powerful transmitter, but due to an antenna system issue, it doesn't receive well. Getting into it with a handheld at only 5 watts can be difficult for beginners and experienced ops alike. Many people use 50 watt mobile FM rigs to compensate for this issue. Its transmit audio can also be low and/or "muffled," making it hard to complete contacts with some low audio portable stations (on sats it's better to talk close to the microphone and loud than far away and low).

AO-91 is of the same design as AO-85 but the AMSAT engineers seem to have addressed the issues AO-85 had. It has a great receive system and great transmit audio. Compared to SO-50, the things that may be difficult for beginners to deal with are tuning the uplink to compensate for the doppler effect, and to a lesser degree, dealing with signal fades.

SO-50 is 2 meters up and 70 cms down. The doppler effect is more pronounced the higher in frequency you go. On 2 meters with FM, you don't need to compensate much, if at all. On SO-50 you never have to tune the 2 meter uplink. You do tune the downlink, which is easy to do because while other people are talking on it, you can hear when it's off frequency, and can easily adjust until it's right.

AO-91 is the opposite. It's 70 cms up and 2 meters down. If you are off frequency on the uplink you may not be able to get in at all. If you don't have full-duplex capability so you can hear the downlink while you transmit (highly recommended), you won't be able to tell. I believe they chose a 70 cm uplink instead of a 2 meter uplink because there is considerable unlicensed 2 meter usage in certain parts of the world that can interfere with the operation of satellites on that band. For example, I have heard reports of hearing cordless phones on sats like AO-51 while it was in range of South America, and taxi cab drivers while it was in range of Mexico.

The other thing beginners may be affected by are signal fades. AO-85 and AO-91 both sometimes seem to have transmit signal fades as they tumble. It probably depends on where you are in relation to the satellite and its antennas, and how it's tumbling, because at least with AO-85, it isn't a persistent issue. But SO-50 doesn't have strong fades at all in my experience.

I personally am very excited about how much excitement and how many new hams AO-91 could bring into the ham radio space communications community. During launch on Saturday the amsat.org website was hard to reach because there were so many people trying to load the liveblog about the launch. Here's to AMSAT-NA for putting this bird up there and for its good life and long service to the community.

NOTE: Even though you can hear the downlink with a rubber duck and maybe even get into the bird with an HT inside a house, you should ideally use a directional antenna like the Arrow II or the WA5VJB cheap LEO yagi. Full duplex operation is also highly recommended.

AO-91 frequencies:

Downlink: 145.960 MHz.
Uplink: 435.250 (67.0 Hz tone)

1. *Technically it's a "transponder" not a repeater but to make it easy to understand you can think of it like a standard analog FM land based repeater, except it's cross band.*

Arthur C. Clarke,

C.B.E., B.Sc., F.R.S.A., F.R.A.S., F.B.I.S.

Born 16th December 1917.

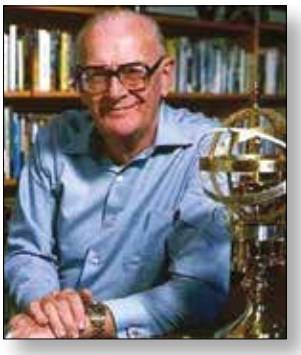


Photo credit ITV/Rex Pictures

Arthur C. Clarke, although not a radio amateur, was actually President of the British Amateur Television Club from 1991 through 2000. He was a world-famous science fiction novelist and he also wrote scientific papers. One of the first of these was a proposal describing the possibility of geo-synchronous satellites for radio & television signals. In October 1945 the Wireless World magazine published "Extra-Terrestrial Relays" **http://www.gr.ssr.upm.es/docencia/grado/csat/material/extraterrestrial-relays.pdf**

This article is amazing in that it clearly showed the concept of geostationary tv transmitters, it even included a link budget which is pretty close to today's numbers (50 watts of RF at the antenna).

This was at a time when no one actually knew if microwave transmission could penetrate the ionosphere. The article goes on to suggest an experiment of bouncing signals back off the moon to prove it. The first mention of EME perhaps?

Solar cells did not exist in those days so his concept of a solar collector focusing the sun's rays onto a steam generator, whilst entirely theoretical, might have been a big problem in practise. Of course, at that time, before the invention of transistors, he would have expected the satellite to have been manned by a plethora of engineers ready to replace valves as they died in service.

He was born in Minehead Somerset, the eldest child of a farming family and became fascinated with science and astronomy at an early age, scanning the stars with a homemade telescope and filling his head with sci-fi tales from magazines like Astounding Stories. He left home in 1936 and moved to London where he worked as a civil servant but soon became a member of the British Interplanetary Society, which championed the notion of space travel long before it was considered plausible. He contributed articles to the group's newsletter and after the war served twice as Chairman of the Society. From 1941 to the war's end, he had been a radar specialist with the Royal Air Force and was involved in the early-warning radar defence system, which contributed to the RAF's success during the Battle of Britain. He spent most of his wartime service working on ground-controlled approach (GCA) radar.

In addition to his many fictional stories about space travel he also wrote a number of non-fiction books describing the technical details and the implications of rocketry and space flight.

He died in 2008, at the age of 90, and by then he had written nearly 100 books many of which had been made into films. He had also produced countless essays and short stories, and made immeasurable contributions to the field of space exploration and science.

As we are, hopefully, at the dawn of the age of geostationary transponders for amateur radio and television it's interesting to look back at one of the forebears of this technology. That the orbit of such spacecraft at 35,786 km is also known as the "Clarke Belt" is due recognition of his contribution.

There are rather more than three spacecraft in the Clarke Belt now

Tim Peake Talk at the RAeS

On the 9th November 2018, ESA Astronaut Tim Peake, who is an Honorary Fellow of the Royal Aeronautical Society, gave a talk to the Space Group of the Royal Aeronautical Society at their Headquarters in Hamilton Place in central London.

His talk, in which he described his mission from the preparations at the launch site at Baikonur until the landing on the steppes of Kazakhstan, was most interesting and he was able to convey all the excitement that he felt during his flight.

Luckily the RAeS make podcast recordings of these talks available on the internet and this one can be heard here:
https://soundcloud.com/aerosociety-podcast

He referred to the many experiments that he undertook and the fact that these included more than thirty intended for educational outreach to school children. He also mentioned in detail

Image credit RAeS

his ten ARISS Ham radio schools contacts. He obviously greatly enjoyed doing them and he also mentioned that there have now been more than 1000 contacts made since the ISS has been in service. "Give us a wave Tim" was a catch phrase that was used during his contacts with HamTV and this must have made quite an impression.

Gérard Auvray, F6FAO, passed away on 17 October 2017.

Gerard, a regular attendee at AMSAT-UK Colloquia, was Amsat-F president. He was very involved in the Hamradio satellite community and contributed to several satellites that were launched in space: Arsène, Sputnik 40, Sputnik 41, Idefix 1 et 2, plus CubeSats like Robusta, QB50 P2, X-cubesat et Spacecube.

He also shared his passion with many students, amateurs and hamradio people. He has contributed to other projects / activities such as providing help during 1985 Mexico City earthquake, promoting experimental balloons and solar balloons and was also involved in the Big Jump project.

Space Talk and FUNcube demonstration at Green Top Primary School, Thorne South Yorkshire.

Dave Ryan M0GIW

Once again, I was delighted to be invited back to Green Top Primary School to talk to class 5 and 6 during their "Space" themed term.

This time we discussed the history of rockets, their uses, and the many notable Engineers and Scientists that worked on their development, from early Chinese fire arrows, Soyuz, Saturn 5 up to the re-usable Falcon 9. We then went on to discuss human space flight, space communications and the many different types of satellites in daily use today.

The highlight of our morning was receiving a fitter message and telemetry from the FUNcube-1 satellite, this year I did not have time to set up an antenna and receiver at the school, however we were simply able to use "Teamviewer" to connect remotely to my shack at the other side of town, using this method we were also able to watch my antennas track FUNcube-1 via an outdoor CCTV camera. Everyone was amazed at the speed of FUNcube-1, and how fast it travelled as we tracked it from Australia to the UK.

Once again, many thanks to the team at FUNcube-1 for uploading our Fitter message.

Feed Back from the School.

I felt that Mr Ryan was very enthusiastic and engaged the children (and me!) very well. It was a unique experience and to receive a message from a satellite was truly special!

I thought the day was really informative, especially the history of space travel section. Mr Ryan was very knowledgeable (and funny!) and kept the children entertained. It helped develop the idea of gravity ahead of our forces work next week.

I loved it! It was so interesting.

AMSAT 2017 Colloquium

This year was a real experiment. After many decades of holding the Colloquium at Guildford in July, we decided to try something different. This came about partly as a result of a massive price hike demanded by the Holiday Inn and also in the hope that E'shail-2 would have been launched and be active by now. In the event, this has not yet taken place but, thanks to the effort of the AMSAT-DL team, we had a perfectly representative operating facsimile to try out. More on this later in the article.

We discussed the possibility of holding our Colloquium in collaboration with the RSGB Annual Convention and worked with the RSGB on developing a suitable plan. Their Convention has historically had three or four "lecture streams" and we were able to add a fifth. The Kents Hill Convention Centre in Milton Keynes has all the accommodation and meeting rooms needed so it worked out quite well. The only limiting factor was the dining facility for the Saturday evening but we were easily able to hold our usual "Gala Dinner" just down the road at the Hilton hotel. This worked very well with all the usual raffle and auction activities and it was super convenient for the many members who were resident there.

Generally, it seems that attendees really enjoyed the new environment, certainly the room was full for almost all of the AMSAT presentations and for some it was standing room only. In addition to the presentations we also had a large booth in the "Club Room" where Jim, G3WGM, and his team were able to dispense news and guidance and also encourage a number of visitors to join AMSAT-UK.

The first session was with Kenneth Ransom N5HVO, he is deeply involved with the ARISS project and he provided a detailed update on how the Schools contacts are scheduled into the astronauts busy programme. We also heard from Ciaran M0XTD who described the ARISS achievements and plans for the future.

The usual "Beginners Session" led by Carlos G0AKI and Dave G4DPZ was very well attended as usual and from simple setups we moved on to a report from Noel G8GTZ on the EME and

other activities that have been taking place at Goonhilly Earth Station using GHY6, one of their 30 metre dishes.

Professor Monica Grady describing some of the early designs for the science instruments on the Rosetta mission

The Keynote speaker on Sunday morning was Professor Monica Grady from the nearby Open University. She was deeply involved with the Rosetta and Philae mission to comet 67P/ Churyumov–Gerasimenko and was able to give us a clear view about the importance of the mission, its science achievements and the amazing technical success of the engineering involved. It was inspiring to see how much of the passion that we have for space is also present in the professional arena.

Achim, DH2VA, with a P4A demonstrator S/X transponder

Future activities were covered by Peter, DB2OS, who talked about the EsHail-2 Geostationary spacecraft that is now expected to be launched in the first half of 2018 and which is planned to provide analogue voice and digital ATV communications for 1/3rd of the earth. We were also able to enjoy seeing a working facsimile of one of the two S/X transponders that it will be carrying. This was put to the test demonstrating both voice and DVB-S signals being transponded from 2.4 GHz to 10400 MHz. We also heard from Chris, M0IEB, on the AMSAT-UK payload for the ESEO mission which, hopefully, will also be launched next year.

In a similar vein, Wouter, PA3WEG, provided a resume of the existing FUNcube missions already in space and added detail of the future JY1-Sat planned for launch within the next few months and Phil, M0DNY, gave us the full details of the UoS3 CubeSat project that is being developed by the University of Southampton with support from the ESA Education Office.

In addition we also enjoyed an update on the latest ideas for SDR systems from the guru Alex Ceete, OZ9AEC, on OPS-SAT from Alessandro Donati from ESA who is also DJ0MDO and on the Libre Space Foundation from Pierros Papadeas.

In terms of "Lesson Learnt", we missed having a proper ground station on display and available for use and would wish to provide that facility again next year. Similarly, the formal AGM was rather rushed due to time pressures and other distractions. We must, in future, again provide more time for members questions and discussions as has been done in previous years.

Thanks to the sterling efforts of the BATC crew, all the presentations were webstreamed live in high definition and are now, as a result of the efforts of Wouter PA3WEG, also available for viewing on YouTube at https://www.youtube.com/user/AMSATUK/videos

In terms of the plans for 2018 – WATCH THIS SPACE! - The committee hope to be able to announce details in January or February.

Minutes of the Annual General Meeting

held at 16:00 on Saturday 14th October 2017 at The Kent Hills Conference Centre, Milton Keynes

1. In Attendance:

- There were approximately 30 members present. In the absence of Prof Sir Martin Sweeting G3YJO the meeting was chaired by Graham Shirville, G3VZV.

2. Apologies:

- Apologies had been received from Martin Sweeting G3YJO, Clive G7SVI, Ray Soifer, and Ken Eaton GW1FKY.

3. Minutes of the 2016 AGM:

- The minutes of the 2016 AGM had been published in Oscar News during the previous year. No objections had been raised as to their accuracy. The minutes were accepted by the meeting as a true record of the 2016 AGM.

4. Matters Arising from the Meeting in July 2016:

- No matters arose.

5. Chairman's Report:

The Chairman made the following comments on last year's activity;

- It was with great sadness that we noted the passing of Pat Gowen, G3IOR had occurred earlier in the year. Pat had been a founder committee member of AMSAT-UK in 1978.
- AMSAT-UK has continued to contribute to the ARISS project, with a very successful ISS contact at the RSGB's YOTA event at Gilwell Park. AMSAT-UK committee member Ciaran Morgan had represented the UK's interests at the recent ARISS International meeting in Rome.
- The FUNcube project continues to be a success. In particular FUNcube payloads were being developed by AMSAT-UK for the European Student Earth Orbiter (ESEO) and for JY1SAT, a 1U cube sat being built with the Crown Prince Foundation in Jordan.
- Under the new editorship of Frank Heritage, M0AEU, assisted by G3VZV and G3WGM, Oscar News has continued to be published quarterly in full colour.

6. Secretary's Report:

- The total current paid up membership as at today was 441, of which 254 are electronic, and 180 postal; and an increase over last year's figures.
- The new rolling membership year had been implemented successfully.
- Three committee meetings had been held during the year, one of these had been held by skype.
- The shop continues to give good service. For various reasons, some items are currently out of stock.

7. Treasurers Report:

- Ciaran Morgan, M0XTD, informed the meeting that the accounts for the FY 2016/2017 had not yet been finalised and would be completed as soon as possible and published in the next edition of Oscar News.
- Ciaran reported that as at today the current account bank balance was approx £96,000, the PayPal account approx £8,300, and the NoChex account approx £326.

8. Election of the 2017/2018 Committee:

- A motion was proposed to re-elect the current Committee plus Dr Chris Bridges M0IEB. This was carried nem con.

9. AOB:

- It was suggested that the arrangements to hold the Colloquium at the RSGB Convention had been satisfactory, but the addition of a Satellite Ground Station was suggested.

There being no further business, the Chairman closed the meeting at approximately 16.20 hours.