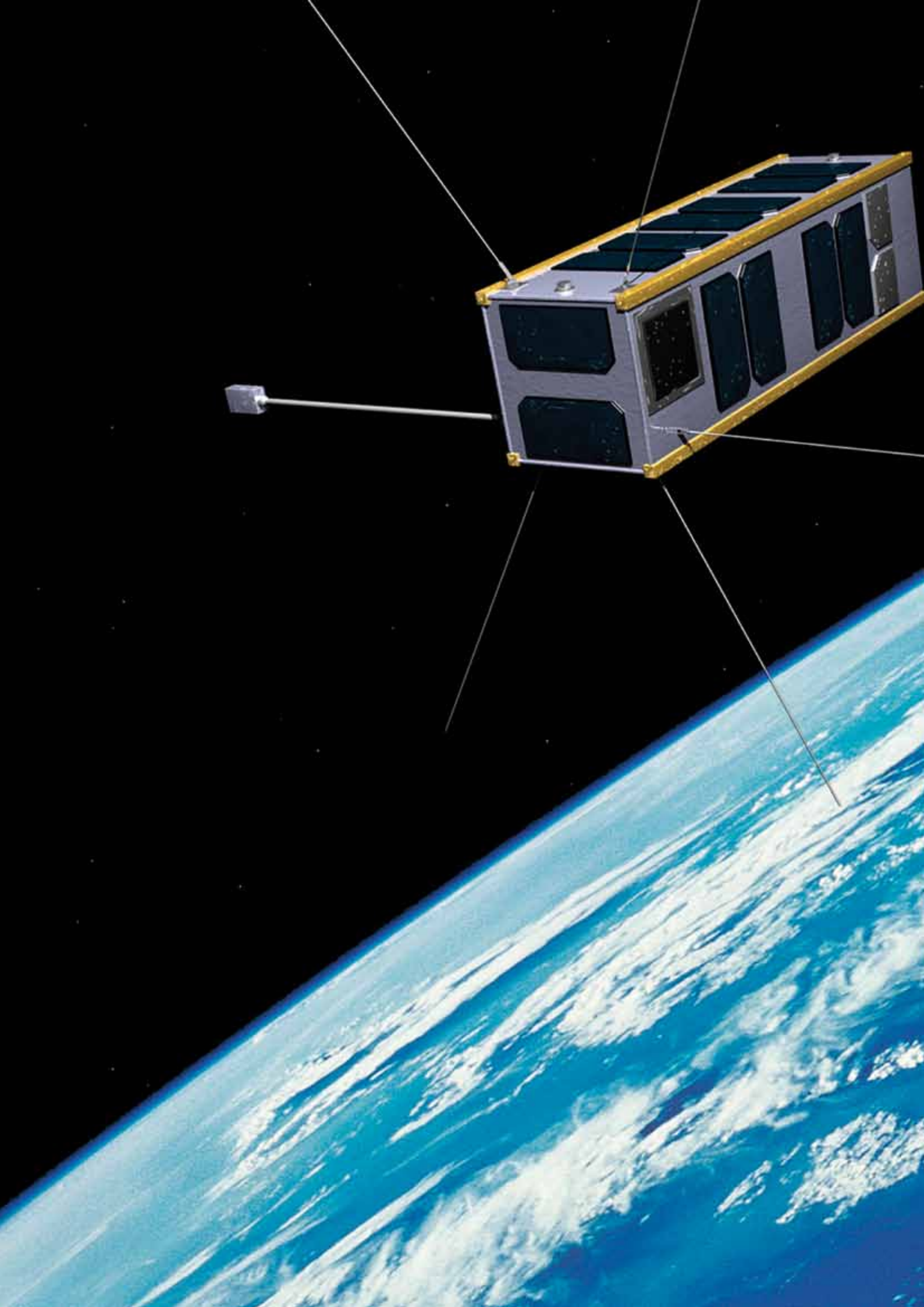




UK SPACE
AGENCY

National Space Programmes
2011-2012



Introduction

Since becoming fully operational in April 2011 the UK Space Agency is delivering a set of national space programmes which complement our investments in the European Space Agency and European Commission projects.



Some of these continue proven, long-term activities managed by predecessor organisations while others represent exciting new initiatives designed to support the growth of the UK space sector. Two are being managed by our partner, the Technology Strategy Board.

Taken together, they will make a major contribution to delivering the six themes of the UK Space Agency's new civil space strategy, which are:

- Growth through exports
- Growth through innovation
- Growth through exploiting new opportunities
- Growth through smarter government
- Science as an enabler of growth
- Education for growth

In ***UK National Space Programmes 2011-12***, we describe these programmes and provide financial and management information that explains how they are run today and how they may develop in the future. In addition, some case studies of specific projects give some insight into the huge range of activities the Agency now manages.

I hope you find it useful.

Dr David Williams

Chief Executive
UK Space Agency

Further information is available on the Agency's website: **www.bis.gov.uk/ukspaceagency**

The Agency welcomes enquiries on its work from professionals and the general public which should be addressed to: **info@ukspaceagency.bis.gsi.gov.uk**



Current National Programmes

The UK has a suite of national space programmes managed by the UK Space Agency and the Technology Strategy Board. Current programmes are:

- The Centre for Earth Observation Instrumentation (CEOI)
- The Aurora National Programme including the Collaborative Research in Exploration Systems and Technology (CREST) and the Aurora KE programme
- The UK Cosmic Vision national programme
- Technology Strategy Board's Feasibility Studies 'Innovation in Space'
- TechDemoSat-1
- UKube-1
- UK involvement in ESA's GSTP (General Support Technology Programme), an optional technology programme of ESA.
- Government Information from the Space Sector (GiFTSS)
- UK Space Agency's Education, Skills and Outreach Programme

Each of these programmes addresses a specific requirement or technology goal. The long-term Agency strategy is to progressively review these national programmes, identifying best practices and highlighting any key areas that are not currently addressed. The Agency and its partners will take an integrated approach to technology development from 'blue skies' research through to demonstration and private investment. In particular, the Technology Strategy Board will work closely with the UK Space Agency to enable the development, commercialisation and exploitation of space technologies.

The National Space Technology Programme

As part of the Government's 2011 budget, the UK Space Agency received £10M of new funding to implement a National Space Technology Programme (NSTP), as proposed by the Space Innovation and Growth Strategy (Space IGS) Report. Through its advisory bodies, the Agency has consulted with the space sector to define the right structure for the NSTP. NSTP will advance UK technologies to higher technology readiness levels (TRLs) with the majority of funding being used to support mid-TRL activities. It will allow UK industry to accelerate innovation, expand sales in the commercial space market and make the UK a stronger player in future international space programmes including those of ESA.

In the short term, the governance of the existing national technology programmes is expected to remain largely unchanged. Some elements of existing programmes may be brought under the umbrella of the NSTP if this would enhance opportunities to promote the technologies and build on established methods. It is hoped that the NSTP will be a rolling programme but this will depend on the success of the first phase. The NSTP is not planned to substitute for UK funding of programmes of the European Space Agency (ESA) nor for space projects funded by the European Union (EU).

The NSTP will be managed by the UK Space Agency's Technology, Science and Exploration Directorate. Programmatic advice will be sought from the Technology Strategy Board and the Research Councils. Existing management processes will be used wherever possible to facilitate rapid implementation.

The £10M will be allocated through several open calls for proposals. It is expected that a balanced programme of small 'Pathfinder', medium-sized 'Fastrack' and larger 'Flagship' projects will be selected.

The first element is a joint call with the TSB and South East England Development Agency (SEEDA) for Fastrack and Flagship projects. The budget allocation is £8.5M comprising £6M from UKSA, £2M from TSB and £0.5M from SEEDA.

A call for dedicated co-located projects to be implemented at ISIC (Harwell) is also planned together with a call for studies of longer term technology, targeted at both academia and industry. Complementary funding is available to allow other government organisations to work with the Agency on the programme goals.

Flight demonstration of UK space technology will be supported through several routes:

- existing ESA programmes
- the TechDemoSat microsat programme
- the UKube nanosat programme



UK Space Agency Centre for Earth Observation Instrumentation (CEOI) Programme

Objectives

The CEOI aims to bring together the UK's academic and industrial Earth Observation (EO) communities in identifying key scientific questions to be addressed through the development of instrumentation. Projects are advanced through the earliest technology readiness levels (TRL) with a view to enabling the UK community to be well placed to benefit from future ESA opportunities.

Funding and Management

The CEOI's budget has been £1M, allocated annually from government, with an additional 20–50% achieved from industrial support. A portion of the funding is allocated to knowledge exchange activities and supporting PhD research.

The CEOI is managed by the UK Space Agency and the Technology Strategy Board via a management consortium. The consortium is led by Astrium along with QinetiQ, RAL and the University of Leicester. Academic and industrial members of the consortium were selected in open competition according to the rules of the Natural Environment Research Council (NERC), where the CEOI contract was previously held.

A number of projects were identified by the original proposal and taken forward. Subsequent projects were selected following open calls to the community for technology projects and evaluated in line with NERC guidelines. A review session was convened on 29 June 2011 and eight proposals were recommended for funding under the CEOI 4th Call; three mainstream projects (including STEAM-R, see the 'Case Study' below) and five seed-corn projects.

The Future

A number of CEOI projects are now sufficiently mature as to require new funding plans to maximize future opportunities and build on the UK's investment to date.

Other technologies, outside CEOI, have been identified which require support to secure ESA return on instrumentation roles for future ESA programmes. The Agency and its partners are reflecting on the future approach for CEOI and in particular the optimum route for taking low TRL technologies through the mid-TRL 'Valley of Death'.

Case Study: STEAM-R

STEAM-R is a key component of the PREMIER mission candidate, currently under study in Phase A by ESA. The work of the RAL team has also greatly enhanced the scientific value of this instrument package. The TRL – raising activity is to meet ESA expectations for inclusion of the instrument in the mission, although additional funding to the CEOI activity is required beyond April 2012. If the PREMIER mission is not selected in 2013, it is expected that the STEAM package could be flown on a Swedish national mission.

UK Space Agency Cosmic Vision National Programme

Objectives

The UK's Cosmic Vision National Programme provides support for the design, development and operation of scientific payloads on ESA missions in its mandatory Science Programme as well as ongoing bilateral missions with non-ESA states. Scientific exploitation of the missions is the responsibility of the Science and Technology Facilities Council which awards grants to scientists through its Astronomy Grants Panel. The Agency and STFC have agreed a dual-key process to ensure coherence and consistency in funding for space science missions.

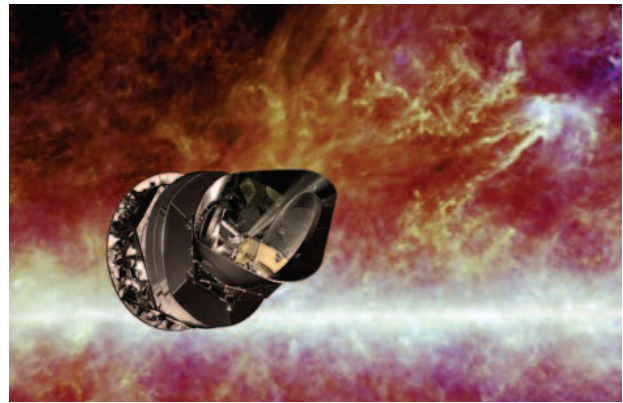
Under the dual key agreement between the Agency and STFC, funding for generic technology to a proof-of-concept level (TRL 3) is available through STFC's consolidated grants process.

ESA's advisory structure selects new missions to enter a four-year competitive development phase aimed at raising technology readiness levels (TRLs) via bread-board and instrument design activities. Cosmic Vision missions are expected to have reached a TRL of 5 prior to selection for implementation, meaning that they have been validated in a relevant environment. This TRL-raising activity is supported by the UK's Cosmic Vision funding, with a view to positioning the UK to maximise future investment return.

Currently, the UK has involvement in three M-class missions in Definition Phase and three L-class missions in Assessment Phase (feasibility study stage). Ultimately two M-class missions and one L-class mission are intended to proceed to launch between 2017 and 2021.

Funding and Management

The Cosmic Vision National Programme has a budget in FY 2011-12 of £14.3M of which approximately £800k is used for early-phase studies while the remainder funds development and mission operations (sometimes called 'post launch support'). Under current Research Council rules, the Agency provides 80% of Full



Economic Costs of agreed proposals from academia, the remainder being provided by the university. Projects are not automatically expected to provide any additional external funding although industrial contributions are encouraged and frequently provided.

The UK involvement in Cosmic Vision is managed by the UK Space Agency. Statements of Interest (SOIs) are submitted to the Agency, outlining potential UK involvement in an ESA mission. SOIs are evaluated by one of the Agency's advisory bodies in terms of scientific return for investment and long-term strategic benefit. For the Cosmic Vision programme, the principal advisory body is the Science Programme Advisory Committee (SPAC).

When a project is ready to move from definition (Pre-Phase A) to development (Phase A), the Agency carries out a full peer review to assess programmatic issues such as feasibility and risk, in addition to UK investment return. At this stage, potential UK technology developments are clearly defined in response to ESA's Announcements of Opportunity (AO) for instrument delivery. This allows the UK to access its potential role within any consortium and focus on maximizing scientific return, leadership and technical capability.

Typically three missions enter into competitive assessment for a single launch opportunity. In addition to study phase activities, the UK Space Agency's Cosmic Vision National Programmes budget currently funds operation of missions already launched and instrument and data processing systems for missions under development.

- Projects in operation are Herschel, Planck, STEREO, Hinode, Swift and SOHO.
- Nationally-funded projects under development are the LISA Test Package for LISA Pathfinder; the Mid-IR Instrument for the James Webb Space Telescope; the MIXS X-ray camera for the Bepi Colombo Mercury mission; and key elements of the European-wide payload data processing system for the GAIA astrometry mission.

A short description of all national projects currently funded by this programme may be found in the accompanying table.

Within the Agency, programme managers oversee each Cosmic Vision project, supported by dedicated project boards or oversight committees. For multi-national instrument development projects for ESA missions, ESA and Member States manage the project using Steering Committees set up under the terms of signed Multi-Lateral Agreements (MLAs).

The Future

In October 2011, ESA Member States will select the M1 and M2 missions in the Cosmic Vision programme. The Agency will work with the UK science community to confirm the instrument projects to be supported for the selected missions and confirm its commitment to ESA. It is expected that the first 'Large' mission will be selected in 2012 and the UK is well-positioned to participate in all candidate missions thanks to preparatory studies already underway.

The Agency has also recently invited requests for funding to support Assessment Phase definition of the four candidate missions for the M3 launch slot (c 2022). These are: ECHO (an exo-planet characterisation

mission); LOFT (an X-ray source timing mission); Marco Polo R (an asteroid mission); and STE-Quest (a fundamental physics mission). Following review by SPAC, small awards have been made to all four projects.

ESA member states are consulted on technology planning and the UK must focus on strategically funding technologies aligned to ESA programme concepts. This will enable the UK to be in a position to target key roles, which was a recommendation of the Space IGS report.

Past investment has secured leading UK roles on payload development but as missions become ever more complex, the boundary between the spacecraft and the payload is less defined. Payloads requiring industrial management may become more common and therefore early funding of the UK community to target and secure ESA technology funding is an important goal. To that end, early stage funding of collaborations between industry and academia to develop sensors and their associated data handling systems has been identified as a high priority. Involvement in this development work is closely linked to ability to exploit the science output and typically involves long-term collaborations between industry and academia.

Phase	Project	Summary
Under Study	Euclid	Euclid is a high-precision survey mission to map the geometry of the Dark Universe and would effectively look back in time about 10 billion years, covering the period over which dark energy seems to have accelerated the expansion of the Universe. Nine UK institutes have involvement in instrument development or data processing/analysis activities.
Under Study	Plato	The PLATO (PLANetary Transits and Oscillations of stars) mission is designed to seek out exoplanets (planets beyond our solar system). The UK has particular expertise in focal plane arrays, instrument control and data processing. Prof Pollacco of Queens University Belfast is the Principal Investigator of the international PLATO Science Consortium, and Queens University Belfast, along with six other UK institutions, has involvement in PLATO.
Under Study	Solar Orbiter	Solar Orbiter will be the first spacecraft to provide close-up views of the Sun's polar regions. The mission orbit is designed to be synchronous with the Sun's rotation providing long duration observations for the first time. This will enable the mission to observe the build up of events such as solar storms. Potential UK instrument contributions include the magnetometer, the Solar Wind Analyser and elements of the Extreme UV Imager and the SPICE spectrometer.
In Development	LISA Pathfinder LTP	LISA (Laser Interferometer Space Antenna) Pathfinder is a spacecraft that will test technologies for the future LISA mission. The aim of LISA will be to detect gravitational waves in space, opening up a completely new 'view' of the Universe. UK scientists from the University of Birmingham, the University of Glasgow and Imperial College London are collaborating on the LTP (LISA Test Package). EADS Astrium Limited is the spacecraft's main contractor. SciSys Ltd develops the satellite's on-board software.

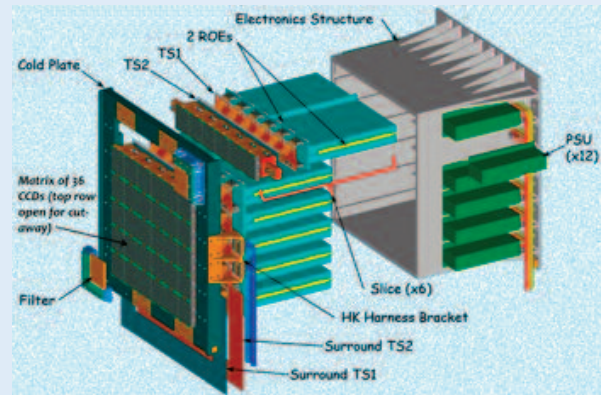
Phase	Project	Summary
In Development	JWST MIRI	The James Webb Space Telescope (JWST) will study the first stars and galaxies. It will also examine the physical and chemical properties of Solar Systems, including our own. The UK Astronomy Technology Centre (Edinburgh) is leading the MIRI (Mid Infrared Instrument) European Consortium of more than 20 institutes. In 2011/12, the instrument will complete testing at the RALSpace, Harwell.
In Development	Bepi-Colombo MIXS	BepiColombo will be only the third spacecraft to visit Mercury in the history of space exploration. Mercury's harsh environment makes it a particularly challenging mission. The MIXS instrument led by Leicester University is the key UK scientific involvement and the project is well underway for a 2014 launch.
In Development	GAIA DPAC	The European Space Agency's Gaia mission will examine the Milky Way in unprecedented 3-D detail. The spacecraft will survey more than one billion stars to make the largest, most precise map of our Galaxy to date. The UK Space Agency has made a £10M contribution to the development of the pan-European Data Processing and Analysis Consortium project led from Cambridge University.
In Operation	Herschel	ESA's Herschel Space Observatory is the largest ever infrared space observatory. It collects radiation from some of the coldest and most distant objects in the Universe. A team led by Cardiff University built the SPIRE instrument, one of the three instruments on board. Scientific operations are ongoing.
In Operation	Planck	The UK has provide instrument technology to the Planck mission which is examining the ancient radiation released shortly after the Universe was formed, known as the cosmic microwave background radiation. Operations and scientific exploitation involves multiple UK groups led by Cambridge University.
In Operation	STEREO	The twin spacecraft of NASA's Solar Terrestrial Relations Observatory (STEREO) are sending back remarkable 3-D images of the Sun. A UK consortium, led by RALSpace, developed STEREO's Heliospheric Imager.
In Operation	Hinode	The Japanese Hinode mission is studying the processes involved in solar flares and Coronal Mass Ejections. Designed and built by teams in the US, Japan and the UK, Hinode has key involvement from MSSL and RALSpace.
In Operation	Swift	Swift is a NASA mission to study gamma ray bursts and their afterglow. The University of Leicester hosts the UK Swift Science Data Centre, providing immediate access to Swift's data 24 hours a day. The University supplied key systems designs for the XRT and built the low temperature CCD focal plane camera and the TAM (Telescope Alignment Monitor). MSSL helped build Swift's UVOT.
In Operation	Rosetta	Rosetta will be the first spacecraft to undertake the long-term study of a comet at close quarters. It is one of the most challenging missions ever undertaken and is due to rendezvous with Comet 67P Churyumov-Gerasimenko in 2014. Rosetta has significant UK involvement from industry and science including the Ptolemy chemical analyser on the lander.
In Operation	SOHO	The Solar and Heliospheric Observatory (SOHO) recently celebrated its twelfth anniversary in space. The joint ESA/NASA project is one of the most successful and longest lasting space science missions of all time. The UK has always been a major player in the SOHO project, from the design and construction to the operation and science.

Case Study: The Visible Instrument on ESA's Cosmic Vision Candidate Mission 'Euclid'

The Visible Instrument is a large optical camera at the focus of the Euclid 1.2m telescope. It will be one of the biggest ever developed for space applications, providing high sensitivity red light images over the half a square degree field of view for half of the sky and more, with extremely fine sampling. The core of the instrument is a matrix of 36 large format (4k x 4kpix) CCD detectors especially developed for Euclid by e2v, in Chelmsford, UK, under contract to ESA. The UK leads the Visible Instrument development for Euclid through the Mullard Space Science Laboratory, University College London, with participation from the Open University, both funded by the UK Space Agency. The team also includes also French, Swiss and Italian groups.

Euclid's primary goal is to measure what is causing the expansion of the Universe to apparently accelerate, in contradiction to what is expected under current theories of gravity. This could be some unknown and new property of gravity, which Euclid will test, or the result of an unknown energy field, for this reason called Dark Energy: in either case large-scale revisions of our understanding of physics is required. The Visible Instrument will make measurements of the small-scale distortions in our images of distant galaxies induced by weak gravitational lensing, which is one of the most powerful ways to measure the properties of this unknown force increasing the cosmic expansion rate. In the process, the instrument will also map Dark Matter to improve our understanding of this

other unknown constituent of the Universe. In addition, the beautiful and detailed images made by the instrument of most of the sky will be both a fundamental resource for almost every aspect of astronomy and will be the reference view of the Universe for everyone everywhere.



The figure shows the focal plane structure of the Euclid Visible Instrument. Each of the 36 CCD detectors has 4 detection chains, which are serviced through the Read Out Electronics (ROEs), one for every three CCDs.

The support structure and the dedicated ROE power supply units (PSU) can also be seen. In addition, the Visible Instrument also includes shutter and calibration units, as well as data handling and instrument control electronics which communicate to the spacecraft, and a large pair of radiators to ensure its correct thermal environment.

UK Space Agency Aurora National Programme

Objectives

Aurora is the European framework for Solar System exploration, focusing on Mars and the Moon. It is an optional ESA programme and currently comprises the ExoMars mission and a development programme for future missions (MREP – Mars Robotic Exploration Preparatory Programme).



The UK's National Aurora Programme complements the investment through ESA and comprises:

- The Collaborative Research in Exploration Systems and Technology (CREST) programme. CREST supports industrial and academic partnerships developing technologies with potential for both exploration and terrestrial applications. Specific Announcements of Opportunities (AOs) for this programme give guidance on priority research areas.

Universities are funded via a Research Council Grant. Industry awards are made directly to the researching company. Sometimes with collaborative projects, the funding may be routed through one of the partners.

- Instrument delivery funding, currently focused on ExoMars. Funding is provided to instrument teams via grants to academia and contracts to industry. The UK's contribution is peer reviewed and prioritized. Potential for technology spin out and science return are key criteria.
- An award programme designed to build the research community by providing studentships and fellowships to promising young researchers, thus maximizing the UK's ability to exploit future science data. There is nominally one call per year and the announcement of opportunity provides guidance on key areas. The call is open to all research institutions and awards are made via grants.
- The Aurora Knowledge Exchange Programme to inject Aurora technology into wider industrial applications to benefit the UK's economy. About £0.5M was awarded to a set of promising projects in July 2011.

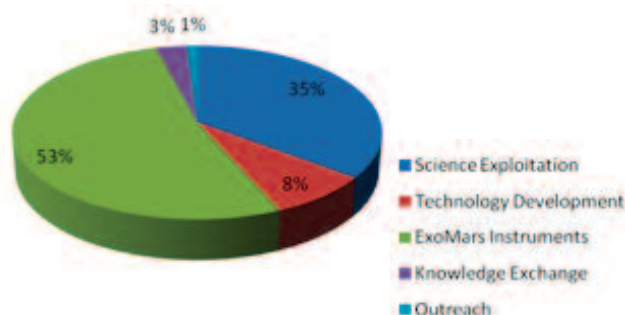
- A Mars exploration outreach programme to fund the development of schools materials and activities. This provides support for outreach officers and cover publications, events and media materials (the latter is via contracts).

Funding and Management

The UK contributes 164M€ to ExoMars (16.5% of the total mission cost) and 6.5M€ to the Mars Robotic Exploration Preparatory Programme. The UK is Principle Investigator for two ExoMars instruments, the Panoramic Camera (Pancam) and Life Marker Chip (LMC, see "Case Study"), and Co-Investigator on two other instruments, the X-ray Diffractometer (XRD) and the Raman Laser Spectrometer (RLS).

The UK Space Agency is responsible for the UK's subscription to ESA as well as the UK national programme. The national programme is managed using community advice provided by the Agency's Aurora Advisory Committee (AurAC) and via project-level management committees.

Aurora National programme budget for 2011/12 is £5.4M. The planned breakdown of national funding (£51.4M) to the end of ExoMars Operations in 2020 is show below:



Technology Strategy Board's Feasibility Studies for Innovation in Space

Objectives

The Technology Strategy Board's Feasibility Studies for Innovation in Space (IIS) programme aims to stimulate innovation within the UK's space sector and encourage use of the International Space Innovation Centre (ISIC) at Harwell, Oxford.

Funding and Management

The IIS has a total budget of £2.4M, funded in approximately equal shares by the South East England Development Agency (SEEDA), the Technology Strategy Board and industry.

Case Study: The Life Marker Chip

The Life Marker Chip is a unique, highly innovative instrument that uses immunoassay protein detection technology developed in the medical diagnostics field to detect the presence of biomarkers, that is, organic compounds indicative of extinct or extant life. Such technologies utilise panels of antibodies loaded on to micro-array chips. These antibodies have been raised against proteins known to be found in biological organisms. If present, the proteinic antigens react with the antibodies and are then linked to fluorescent chemicals which are detected by means of optical micro-sensor technology thereby giving immediate visual confirmation of the presence of biomarkers.

The Life Marker Chip will complement the MOMA and RLS instruments on the Rover that will characterise any organic compounds present but will be much more specific than these. With only a maximum of 24 different antibodies it is likely the LMC will only examine samples of Martian subsoil that have already shown evidence of existence of organic compounds by these two instruments. As the LMC can detect biomarker molecules at such high sensitivities as parts per billion and trillion it offers the best opportunity for confirming the presence of life on Mars. The UK is the principal investigator for this instrument.

The early development of this instrument was funded through CREST and ESA TRP. The Aurora instrument development line funded the instrument after it had been selected. Technology spin-out is now being funded through the Aurora Knowledge Exchange Programme.

Nominally funding is split 75:25 between public and private investment. However, the detailed rules developed by the Technology Strategy Board entitle some large commercial organizations to only 50–60% funding. Partnership is encouraged but, not compulsory, and there are rules relating to the split of funding within partnerships.

The TSB manages the IIS scheme and it is implemented by a dedicated competitions team. The TSB's Head of Special Projects advises on the scheme's scope, in consultation with Lead Technologists for Space, and makes recommendations. The Director of Operations ultimately makes the funding decisions.

Projects were vetted for basic competition criteria and then three assessors per project were randomly picked from a pool selected by the TSB. Assessors were asked to judge each project's scope and score it against given criteria. Final scores were aggregated and checked.

The Future

The 77 projects that were successful in gaining funding will be undertaken between 1 May and 31 July 2011. They will be invited to present at the Technology Strategy Board's "Collaboration Nation" event in autumn 2011.

A basic analysis of all applicants by sector, company size and location is underway and this will be published.

Twenty of the projects either use the ISIC facilities at Harwell, Oxford or have a link to ISIC within the feasibility study. A great number of projects have potential for ISIC links once they have been developed beyond the feasibility stage.

To date, the scheme has been well regarded but some lessons have been learned for the future. The scope of the scheme was deliberately wide with the result that assessors found it difficult to compare diverse applications. It may be necessary to limit the number of contracts awarded per company in order to achieve a balance in the size of companies participating.

A workshop reporting on the results of the studies has been held and a brochure containing abstracts of each project has been published.

TSB/UKSA TechDemoSat Programme

Objectives

The TechDemoSat is a 150kg-class microsatellite designed to provide an in-orbit test bed for innovative UK space technology. The scheme was recommended in the Space IGS report as a way of overcoming a major barrier in getting new technologies to market. The project was initiated in October 2010 with a target launch date for TechDemoSat-1 in 2012.

Funding and Management

TechDemoSat has a budget of £3.5M for platform design and integration; £3.0M from the Technology Strategy Board and £0.5M from SEEDA. The UK Space Agency is contributing funding from the National Space Technology Programme to develop the Mission Planning System. Surrey Satellite Technology Limited (SSTL) leads the project and receives a grant from the Technology Strategy Board which adds to its self-funding of about £3.5M. The target is to have the overall budget funded equally between the public and private sectors. All equipment must be fully funded by payload providers.

A successful Project Definition Review (PDR) was achieved in February 2011. The preferred launch opportunity is under selection and will be announced

in due course. Funding for operations at ISIC at Harwell, Oxford has yet to be confirmed but may form part of the TSB's commitment to ISIC.

The project was selected through the TSB's 'Exceptional Projects' process, which is a collaborative R&D competition. The single applicant demonstrated that theirs was a high impact proposal with unique capabilities to benefit the UK economy.

A group of independent assessors scored SSTL's application form and held a review meeting to agree recommendations. These were reviewed by the TSB's Head of Special Projects and the final funding decision was made by the Director of Operations.

As part of the project, SSTL managed the payload selection process, inviting proposals from any UK organization with launch-ready technology. An initial selection and systems engineering study was carried out in conjunction with VEGA Space. A Payload Providers Group has been established to provide a mechanism for resolving any disputes with SSTL.

The Future

A launch plan for TechDemoSat-1 will be confirmed as part of a Memorandum of Understanding between the UK Space Agency and ISRO. Ground segment and operations plans at ISIC will also be established.

More TechDemoSats are planned for the future and a grant structure will be established in conjunction with the UK Space Agency. The possibility of a 'Europeanised' TechDemoSat programme is also under consideration.

The TSB and the UK Space Agency recognise that potential payload providers need to be informed about technology demonstration missions as far in advance as possible. With that in mind, the funding and timing of TechDemoSat-2 will be agreed and announced in due course.

UK Space Agency/TSB/STFC UKube Programme

Objectives

The UKube programme uses cubesats (miniaturized sub-10kg satellites) to provide small technology demonstration payloads with rapid access to space, thus accelerating technology readiness. A typical mission development timescale is only 18 months.

Funding and Management

The scheme is being piloted by UKube-1 which started in 2010 and is planned for launch in 2012. UKube-1 has a budget of £600k. This covers launch, platform

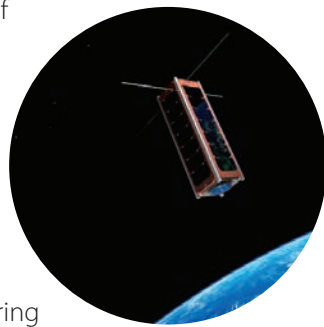
development and operations. Payload providers are expected to provide a major part of their own funding while the platform and launch is provided through the UK Space Agency and its partners TSB and STFC.

UKube-1 is managed by the UK Space Agency with a full-time project manager seconded from the industry sector.

The payloads for UKube-1 were selected from 21 proposals received in response to an Announcement of Opportunity (AO). The successful payloads are: a CMOS Imager Demonstrator; FunCube; Janus; myPocketQube and TOPCAT. More information on these payloads is available on the Agency web site. Selection criteria included: a clear need for an in-orbit demonstration; the benefit of the technology to the UK; and the ability to deliver on a rapid timescale. Proposals were scored against criteria at each stage of the selection process.

The Future

Subject to the outcome of UKube-1, the Agency's intention is to have a rolling programme of UKube launches at a rate of one per year. Consideration is being given to preparatory funding of payloads and assisting providers in offering more ambitious technology payloads to be engineered for in-orbit demonstration. Further development of cubesat systems to include, for example, miniaturized attitude control systems will enable platform technologies to be introduced to the programme in the future. In addition to technology-driven payloads, scientific and educational projects will be included to ensure the broadest scope and appeal. In parallel to the UKube-1 programme, several studies for new cubesat technologies have been supported by the TSB's Innovation in Space Studies and will feed into the development of future UKube missions.



ESA's General Support Technology Programme

Objectives

ESA's General Support Technology Programme (GSTP) exists to convert promising engineering concepts into mature products. It covers a broad spectrum from individual components through subsystems up to complete satellites.

Funding and Management

The scheme is managed by ESA through the Programme Management Office at the European Space Research and Technology Centre (ESTEC). Projects are selected via ESA's Invitation to Tender (ITT) process, a permanently open announcement of opportunity (AO) or direct negotiation.

ESA provides periodic reports evaluating the programme, in complement to more information monitoring processes and liaison with UK recipients.

Competitive procurement is generally used for 100% funding, although up to 50% funding is possible in non-competitive tenders.

There are currently at least 50 potential UK projects. The table below shows the UK's GSTP budget (used or planned) as at April 2011:

K€	Net Contribution	Contracts Awarded or Committed	Balance 2011/2012	Cumulative Balance
GSTP-1	832	801	31	31
GSTP-2	4,382	4,636	-254	-223
GSTP-3	11,311	6,715	4,596	4,373
GSTP-4*	2,672	5,419	-2,747	1,626
NEWPRO	0	800	-800	826
PROBA-3	4,700	2,550	2,150	2,150
GSTP-5	2,400	1,970	430	430

*€300k GSTP-4 released following withdrawal of contractor

Future

The Agency recognises that a larger UK contribution to GSTP is desirable in order to remain competitive in developing technologies. Other nations fund at a level of ~€500k per project but the UK typically

Case Study: UKube1 CMOS Imager Demonstrator

The CMOS Imager Demonstrator instrument is being developed as a collaboration between the Centre for Electronic Imaging at Open University and e2v technologies, a world-leading supplier of scientific imagers into the space market. This imager is based on a new

sensor technology for space use, based on 0.18micron CMOS technology. The instrument is largely being developed by e2v-sponsored PhD students, will be designed to perform a variety of imaging tasks, including taking pictures of the earth, and to be an experimental test-bed for radiation damage effects in space.

contributes only €100-200k per project. Given its strategic positioning role, GSTP is a vital bridge for UK technologies and historically low contributions means the UK have previously ceded or lost leadership opportunities. The UK must look to better negotiate future funding decisions and face the challenge of engaging more fully.

As an interim measure, subject to review of proposals, the Agency is committing an additional £1M to GSTP5 from the funding made available through the NSTP.

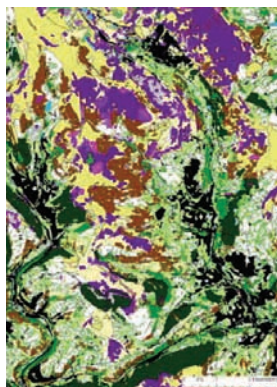
Government Information from the Space Sector (GIFTSS)

Objectives

The GIFTSS programme (Government Information from the Space Sector) supports delivery of government policy objectives. It has four high level objectives:

- Increase routine uptake of appropriate space information into routine operational processes;
- More effective users where this can be made possible through the use of appropriate information derived from space assets;
- Increase involvement of other appropriate areas of support from academia, institutes and industry;
- Increase the 'critical mass of innovation' in UK industry in these areas.

Funding and Management



The programme is jointly funded by the UK Space Agency together with end-users. It has a budget that varies from year-to-year depending on the extent and nature of projects under development. The Agency works in partnership with end-users to develop projects. It uses sector facilitators, who work with

end-users to develop project ideas and with User Support Experts who assess the technical feasibility of the projects.

The Future

The GIFTSS programme is expected to become part of a broader end-user service to be offered by the Agency. A recent review of the GIFTSS programme found end-users valued the GIFTSS programme and would like UK Space Agency to extend the range of services it facilitates in partnership with end-users.

UK Space Agency's Education, Skills and Outreach Programme

The Agency's Education Programme delivers the Agency's Education, Skills and Outreach Strategy issued in 2011. It addresses two distinct, although related, issues:

1. Space for Education

Space has demonstrated a remarkable power to inspire widespread interest in science, technology, engineering and mathematics (STEM) and provides exciting contexts for the teaching of a range of subjects.

2. Education for Space

Growth of the space sector is hampered by the scarcity of graduates and technicians with relevant qualifications and action is required.



In practice, these aspects are mutually supportive and actions may address one or both themes in varying measure. In order to address these issues the Agency works with its partners in government, industry and elsewhere to:

- Continue to review and monitor the skills needed by the UK space industry and develop plans to address these needs;
- Work with those responsible for the development of information, advice and guidance for all ages, to ensure that support and materials on careers in the space industry are easily accessible, including role models (mainly for younger pupils), work experience, internships and information on jobs (mainly for older pupils and students);
- Encourage and support the use of space as an inspiring context for learning across all age groups, but with emphasis on:
 - o supporting non-specialist primary teachers in the use of space in teaching
 - o improving the quality and availability of teaching materials using space across the curriculum for primary and secondary schools and for colleges (mainly through ESERO-UK, the UK Space Education Office)

- o engaging pupils in STEM through the use of space and maintaining and developing the interest of the most enthusiastic students by providing suitable opportunities.
- Develop and implement wider outreach programmes to improve awareness and engagement with the UK's space programme, in particular by organising a National Space Conference.

Examples of ongoing programme elements include:

- The 'Space for All' outreach grants programme, now in its third round of awards
- The Agency's scholarships for UK students to attend the International Space University
- Support for the UK annual 'Space School' programme at NSC Leicester
- Support for UK involvement in the international 'Space Settlement' Competition for schools.

The Agency's planned budget for the Education, Skills and Outreach programme for Financial Year 2011-12 is £297k (see table for breakdown).

Budget element (£k)	2011/12
Careers	5
Space for Education	155
Supporting UK space	50
Outreach	77
Other (mainly web support)	10
Total	297

The Careers budget covers liaising with industry and careers advice, giving talks at key events and in schools, and running workshops at conferences/events.

The Space for Education activities will be closely integrated with the work of ESERO-UK which has a focus on using space as a context to inspire learning. ESERO-UK will be used wherever possible to reach relevant parts of the education system—in particular teachers and students. Space for learning also encompasses Mission X (see Case Study) and the Space Academy. The Space Academy began operating in the East Midlands, but is intended to be rolled out to a national model, including a base at Harwell using resources provided by STFC. The current pilot has achieved very good results over three years, delivering masterclasses to over 3000 students at GCSE and A-level and training 225 teachers to use space to deliver the curriculum.

Case Study: Mission X

During the early Spring of 2011, the Agency piloted an international programme to use the example of health and fitness in astronauts to inspire understanding of the science behind diet and exercise as well as a change in habits among upper-primary and lower-secondary school pupils. This proved extremely successful, with six primary schools and one secondary school in Essex working together for ten weeks and drawing in 200 pupils. The wide range of subjects included and the international aspects of the challenge were especially valued by the teachers.

A wider rollout of the next phase is planned in 2011/12, using the same materials developed by the nine international partners (led by NASA, and including ESA, DLR, and other agencies), and updated in the light of existing joint experiences. This will reach schools across the country, based initially around the locations of the ESERO Space Ambassadors across the UK.

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.

Second only to the USA in space science, the UK's thriving space sector contributes £7.5bn a year to the UK economy, directly employs 24,900 and supports a further 60,000 jobs across a variety of industries.

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

The UK Space Agency is an executive agency of the Department for Business, Innovation and Skills (BIS).

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