

Upstream UK Capabilities

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Platforms

LEO, MEO, GEO
Cube-, Nano-, Micro-, Small- and Large-sats
Deployable in high inclination LEO, or HEO/Molnya if needed
High Altitude Platforms (winged and dirigible)
Guest payloads on third party platform e.g Euro Iridium





Cubesats

Imaging constellations



Near space



Payload accommodation services (e.g. Euro Iridium)







Large EO missions

Subsystems & equipments



Platform technologies

- Structures
- Thermal management
- Tankage

Many subsystems & some equipments are available in the UK, or can be readily procured in Europe

Electrical

- Systems
- Harnesses

AOCS systems

- Sun, star & Earth Sensors
- Gyros, Reaction/momentum wheels
- Magnetometers

Thermal

- Coolers
- Radiators
- Heat pipes

RF systems

- X, S, Ka band
- Telecomms & GNSS
- Antennas

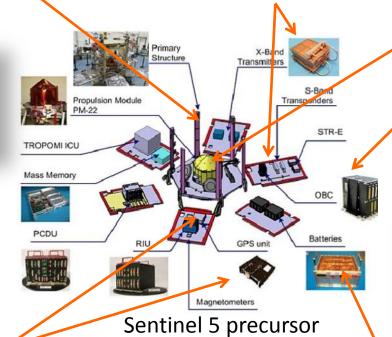
Propulsion

- Chemical Thrusters
- 'Green' propellants
- Electric propulsion

Data Systems & Avionics

- OBC and SAR processing
- On board data handling
- TT&C

NB: small spacecraft manufacturers normally build most of their own subsystems & equipments



Mechanisms

- SADM
- Scan mechanisms
- Other mechanisms

Power systems

Batteries Solar panels

Calibration & AIV/AIT

Shake and bake Propulsion test facilities (electric & chemical)

Clean rooms Magnetic & mass properties

EMC & RF Shock (inc pyro) and drop

Acoustic Radiation



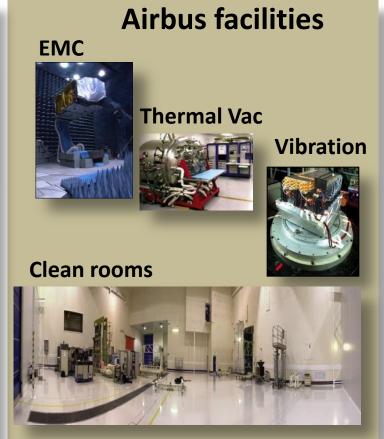
Instrumentation calibration

GEOI

Large facilities

Specialised facilities





Other

A comprehensive survey of UK AIT facilities (and gaps) has just been completed by UKSA, and will be available soon.



RADAR

Sea Ice thickness, type (age), extent, motion Ice sheet elevation, motion, mass balance Climate change, Ionosphere Environmental (spills, releases)

24hr land use & surveillance

Disaster monitoring
Shipping & ship monitoring
Oceanography
Geophysical
Weather

CEOI

GEO

NSTP

Other

SAR

On Board SAR Processing (Airbus, BAE Systems)
Wavemill/OSCM (Airbus, NOC))

Airbus can design & build virtually any kind of SAR imaging system P, S, L, C, X, INSAR, polarimetric.

High impact for polar regions (BIOMASS)

Altimetry

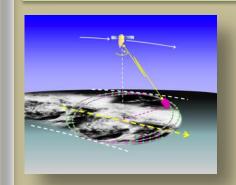
SSTL + Airbus have an altimeter (on TDS-1).

Altimetry is vital for monitoring sea ice extent, thickness, and ice sheet evolution.

UK is world class in altimetry science but has not pursued hardware

Other

WIVERN (Rain, Wind Clouds – 94GHz) (UoReading, RAL, Airbus)



Optical & IR Imaging

CEOI

Ice extent and motion
Infrastructure development & land use
Visible pollution signatures
Surveillance

Human issues and environment

Fires & disaster monitoring

Surveillance – shipping and fisheries

Geophysical and vegetation

CEOI

NSTP

Other

Imaging & Hi-Res video

4k Video & Hi-Res Imaging (OptiSAR) (SSTL)

4k Video & Hi-Res Imaging (RAL)





Multi/Hyperspectral

Low cost image slicing hyperspectral (Univ. Durham)

TRUTHS (NPL)



Detector arrays (e2v & Leonardo)

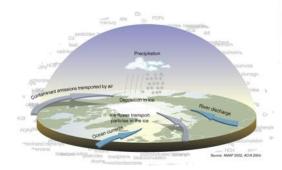
Thermal IR

TIR Detector Arrays (Leonardo)



Spectroscopy

Oil pollution (VOCs)
Greenhouse gases (CH₄, CO₂ etc.)
Atmospheric composition (NO_x, SO₂, O₃ etc.)
Environmental damage (spills, releases)
Permafrost degradation





CEOI

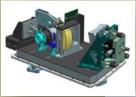
NSTP

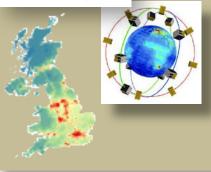
Other

Optical

CompAQS & others (UoL, SSTL)

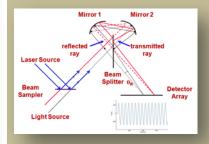
OmniSat - HAPI (Thales UK, UoL)





NIR/SWIR

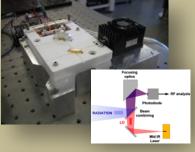
μFTS (RAL, SSTL, Selex)

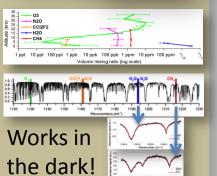




Mid-IR

LHR (RAL, Selex)





mmWave/THz

STEAM, LOCUS

(RAL, Leeds, STAR Dundee, JCR, Airbus)





Radiometry

Ice extent & type (microwave)
Climate signatures (ice extent, type)
Surface temperatures (Sea and Land, IR & microwave)
Atmospheric parameters (GNSS-R)
Earth radiation budget



CEOI

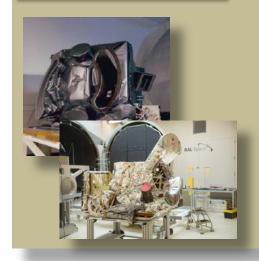
NSTP

Other

Infrared

ATSR heritage & calibration (RAL Space)

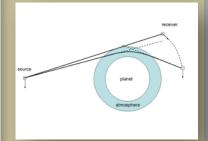
IR Detectors
Leonardo (SELEX)



GNSS-Occultation

SGR-ReSI adaptable for occultation sounding (SSTL)

Sounding of pressure, temperature, humidity



Microwave

Receiver components for MLS, MHS, AMSU etc. RAL, JCR, Sula

183GHz channels on MLS Mixer tech for MHS, AMSU 150GHz, 183GHz

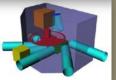
Schottky diodes Teratech, RAL

Broadband

BBR for EarthCARE Thales UK(SEA), RAL GERB 2,3,4 RAL, Imperial, Met O

TOA radiation budget





Scatterometry & Other



Oceanography, surface wind speed, sea wave state Ice extent, type

Ice sheet weight, geoid **Canopy height and health** Ice sheet elevation



CEOI

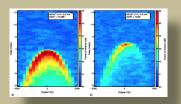
NSTP

Other

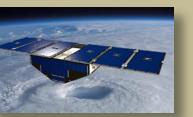
GNSS Reflectometry

SGR ReSI (SSTL)



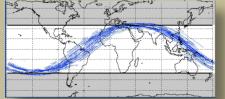


A low-cost passive (bistatic) scatterometer using reflected GNSS signals



90 min coverage with 8 s/c

Flying on TDS-1 and embarked on 8 s/c in NASA CYGNSS mission



LIDAR, Gravity sensors

Canopy LIDAR (Univ Edinburgh, UCL) LIDAR technologies (QinetiQ, Heriot Watt) – All low TRL w.r.t. space

Gravity sensors (U Glasgow) Cold atom gravimeters (U Birmingham, others)



Potential Missions

- Missions complementary to Copernicus, and acknowledging high latitude mission plans of other countries (e.g. Cassiope, ALTIKA)
- European high inclination, or HEO/Molnya deployment
- Possibilities:
 - Constellation of cubesats
 - Single smallsat or constellations thereof (e.g. NovaSARs, Imagers)
 - Guest payloads (on e.g. Euro Iridium (with 86.4° inclination)
 - Larger platform mission
 - Additional payloads on altimetric and/or SAR missions?
- A multilateral approach with e.g. Canada and the US



Summary of UK capability

- UK can build and launch any spacecraft, and provide many subsystems for deployment in a Polar application
- Can provide any SAR payload, including new low cost systems
- Can address many EO instrumentation needs
- Some new innovative sensors are at TRL 4/5, and require airborne or IOD demonstration flights
- Some sensors are small and suitable for cubesat and hosted payload deployment