



RAL Space Industry Day 10th July

Welcome. Prof. Chris Mutlow. STFC RAL Space Director





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Facilities Council



RAL Space Industry Day 10th July

Robert Elliott, Head of Business Development, RAL Space Facilities, Funding, Opportunities





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RAL Space Industry Day 10th July

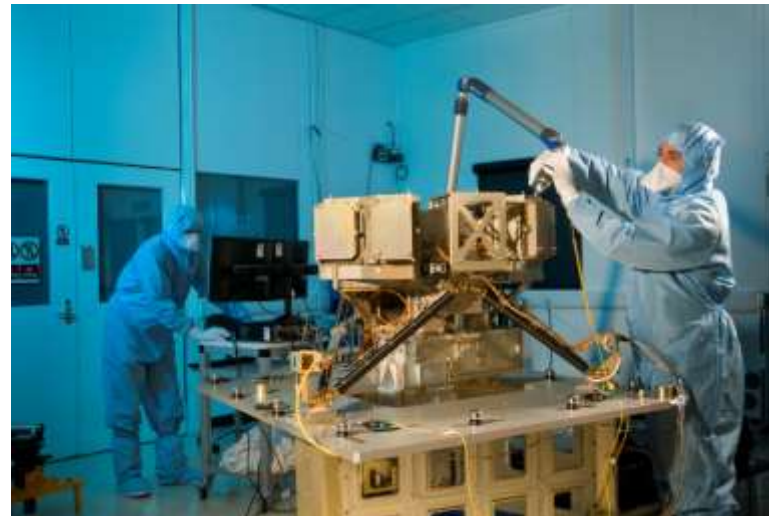
Open Cosmos





RAL Space Industry Day 10th July

Energys ABSL





11:00: RAL Space Facilities

- **11:01 Satellite Hardware Testing Facilities (A) - Presented by Matt Fletcher**
 - Environmental Testing & Qualification (Content lead: Matt fletcher)
 - National Satellite Test Facility (Content lead: Matt fletcher)
 - Payload Calibration Centre (Content lead: Dave Smith)
 - Clean Rooms (Content lead: Matt Fletcher)
- **11:13 Manufacturing Facilities and Services (B) – Presented by Ed Jones**
 - Multi-Layer Insulation Facility (Content lead: Ed Jones)
 - Precision Machining Facility (Content lead: Matt Beardsley)
 - Millimetre-wave Technology (Content lead: Brian Ellison)
 - Space product and quality assurance services (Content Lead: Richard Stamper)
- **11:28 Scientific Facilities (C) – Presented by Rain Irshad**
 - Quantum Space Laboratory (Content Lead: Andy V)
 - Laser Spectroscopy Facility (Content Lead: Damien W)
 - Radio Frequency Propagation Facilities (Content Lead: Spiros V)
- **11: 40 Space Systems Design Facilities (D) – Presented by Gayatri Patel**
 - Electronics Design & Assembly Facility (Content Lead: Gayatri Patel)
 - Optic Design Facility (Content Lead: Nick Waltham)
 - Concurrent Design Facility (Content Lead: Will Grainger)
- **11:49 Ground Segment & Operations Facilities (E) – Brian Ellison**
 - Chilbolton ground RADAR and Antenna farm (Content Lead: Brian Ellison)

RAL Space

RAL Space Industry Day

Wednesday 10th July
10:00 - 14:30
R100 Space Test Facility, Harwell Campus

Find out how the extensive space facilities
and expertise at RAL Space can help your
business, now and in the future.

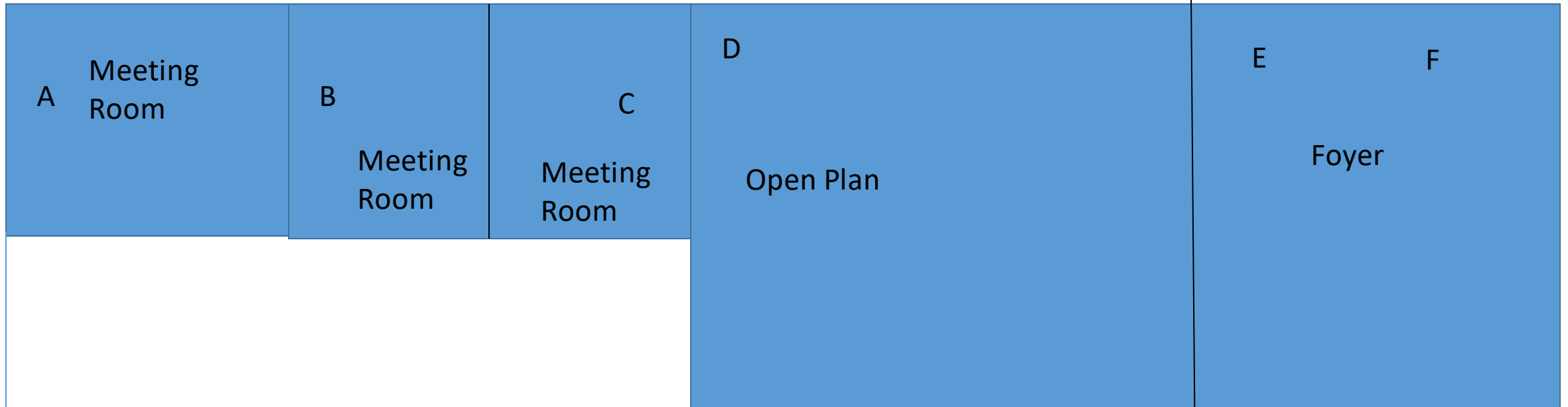
1-2-1 Session Meeting Points



Pop up

Pop up

Pop up

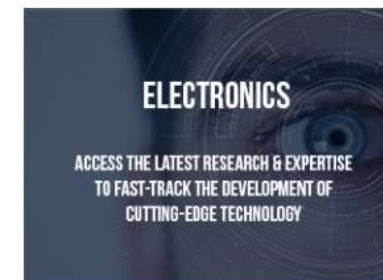


- B4I delivers a multidisciplinary approach to challenges, utilising facilities and world-leading expertise in the following areas:

Lead B4i Contact: Ling Xu

“Working with STFC was a great experience and benefited Exgence in multiple ways. From providing invaluable technical advice, to structuring and organising the project workflow to fit in with our aims, as well as supplying the resource to achieve this at a time when we needed it most.”

Erol Chioasca, Managing Director, Exgence





By taking part in B4I, UK companies gain:

- Funding for projects aiming to solve product, manufacturing or process issues
- Funded access to STFC's world-leading science facilities
- Extensive support from scientific and technical experts with proven track-records of solving complex industrial challenges
- Most projects cost up to £50,000 and last between 3 and 12 months
- 2 stage process : Challenge statement then costed proposal worked up with STFC

“Working with STFC was a great experience and benefited Exgence in multiple ways. From providing invaluable technical advice, to structuring and organising the project workflow to fit in with our aims, as well as supplying the resource to achieve this at a time when we needed it most.”

Funding: Analysis for Innovators (A4I)



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A4I is an Innovate UK funded programme

A4I Analysis for
Innovators

- Allows UK businesses to access cutting-edge R&D expertise and facilities to solve problems that could not be tackled using standard measurement and analysis techniques.
- The Science and Technology Facilities Council is a key delivery partner alongside the National Physical Laboratory, UK National Measurement Laboratory at LGC and the National Engineering Laboratory,
- This popular funding programme is aimed at businesses of any size and with any type of pre-existing measurement or analysis problem.
- To apply, companies need to describe the problem and the impact that finding a solution would have. A4I will then match companies with the best UK scientists and facilities to solve it

Contact Ling Xu, Programme Manager

- International Science Facilities where STFC operates (e.g. CERN, ESO, ESRF) need companies to supply a vast range of products and services
 - CERN alone spend £350million pa on these
- UK companies have won over £240million in the past 10 years
- STFC provides free assistance to UK companies access opportunities
- www.stfc.ukri.org/tender
- tenderopportunities@stfc.ukri.org



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International Business Opportunities

There are significant opportunities for UK companies to supply the international science facilities in which the UK is a member.

The market is huge – CERN alone spend ~£350 million every year on products and services.

The facilities' requirements range from off the shelf products, to services, to high tech bespoke items.

Don't miss out – UK companies have won over **£240 million of work** from these international facilities in the past 10 years*

STFC provides free assistance to help UK companies access these opportunities, including tender notifications by sector and targeted events and site visits.

Learn more and register here: www.stfc.ukri.org/tender
Contact us here: tenderopportunities@stfc.ukri.org

*UK industry has won £239,027,107.38 in contracts from 2008 – 2017 from CERN, ESO, ESRF and ILL.



Opportunities for business & collaboration with RAL Space



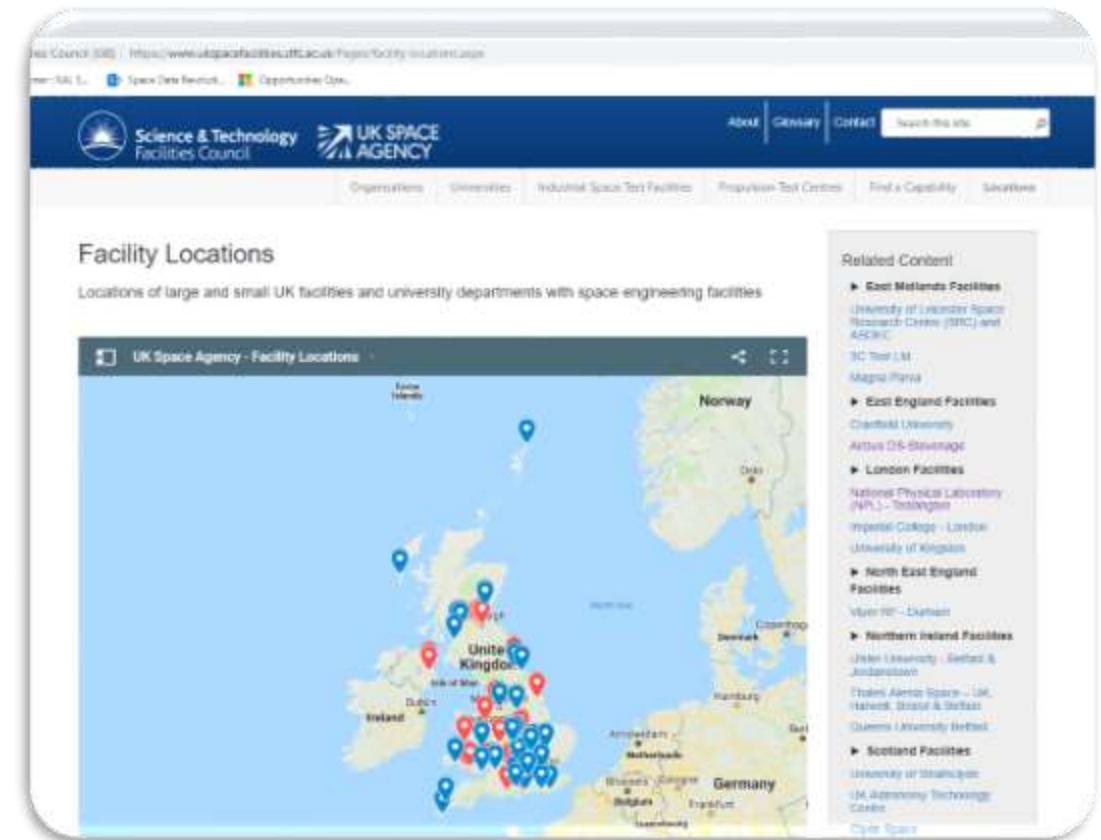
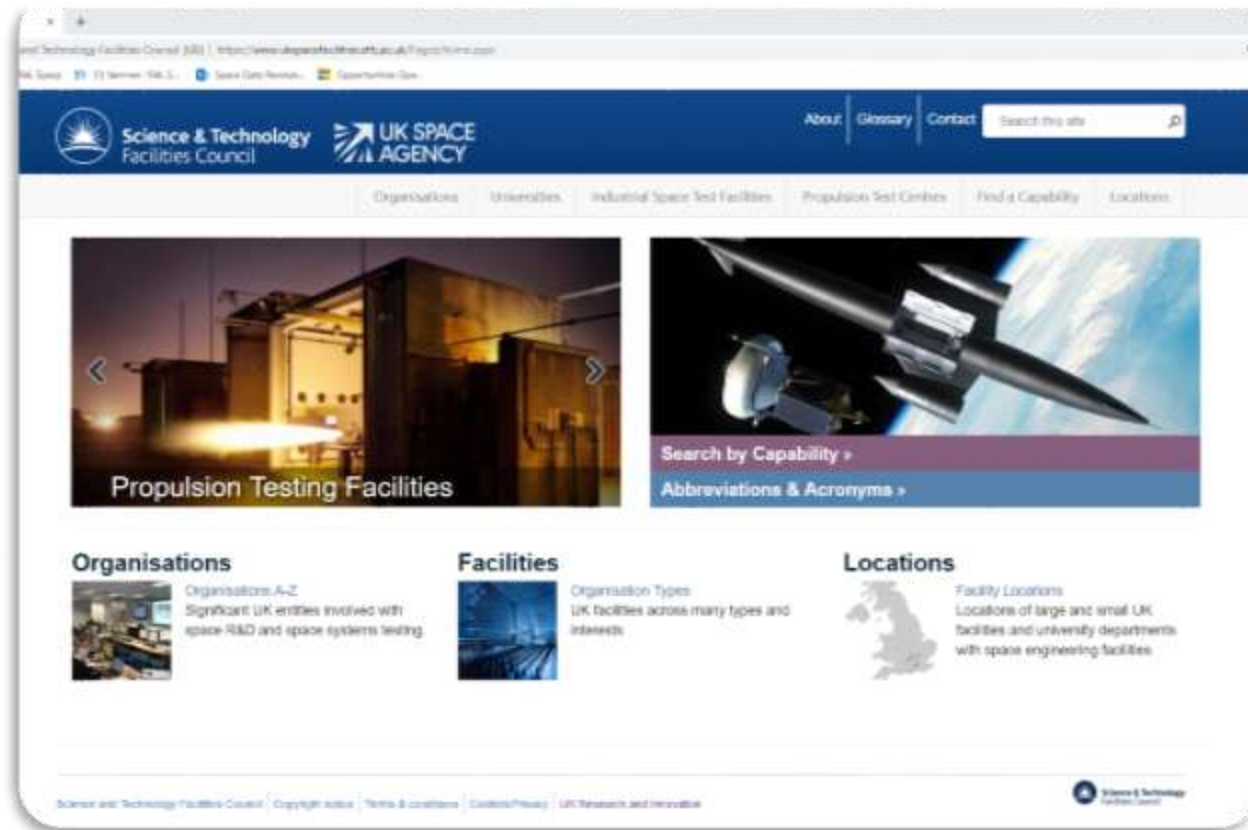
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Other UK Space Test Facilities



<https://www.ukspacefacilities.stfc.ac.uk>



Come and See Us at Stand D9



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UK SPACE CONFERENCE

24 - 26 SEPT 2019

24 - 26 SEPT **2019**

International Convention Centre (ICC) Wales

Established as the most influential event for space in the UK





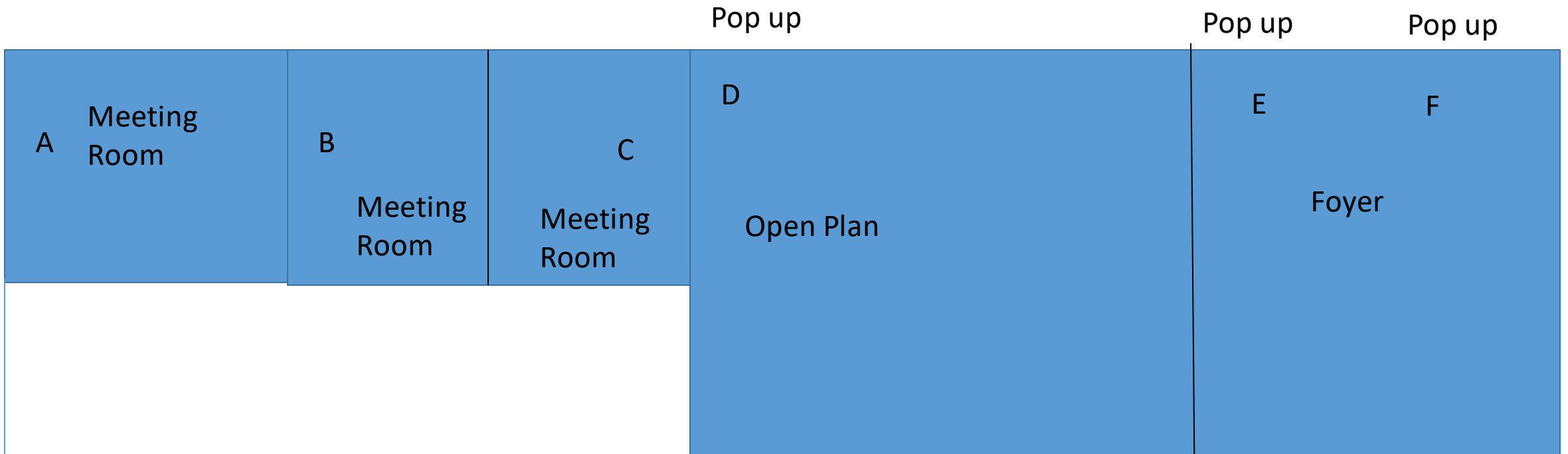
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RAL Space Industry Day 10th July Facilities Pitches



1-2-1 Session Meeting Points





11:00: RAL Space Facilities

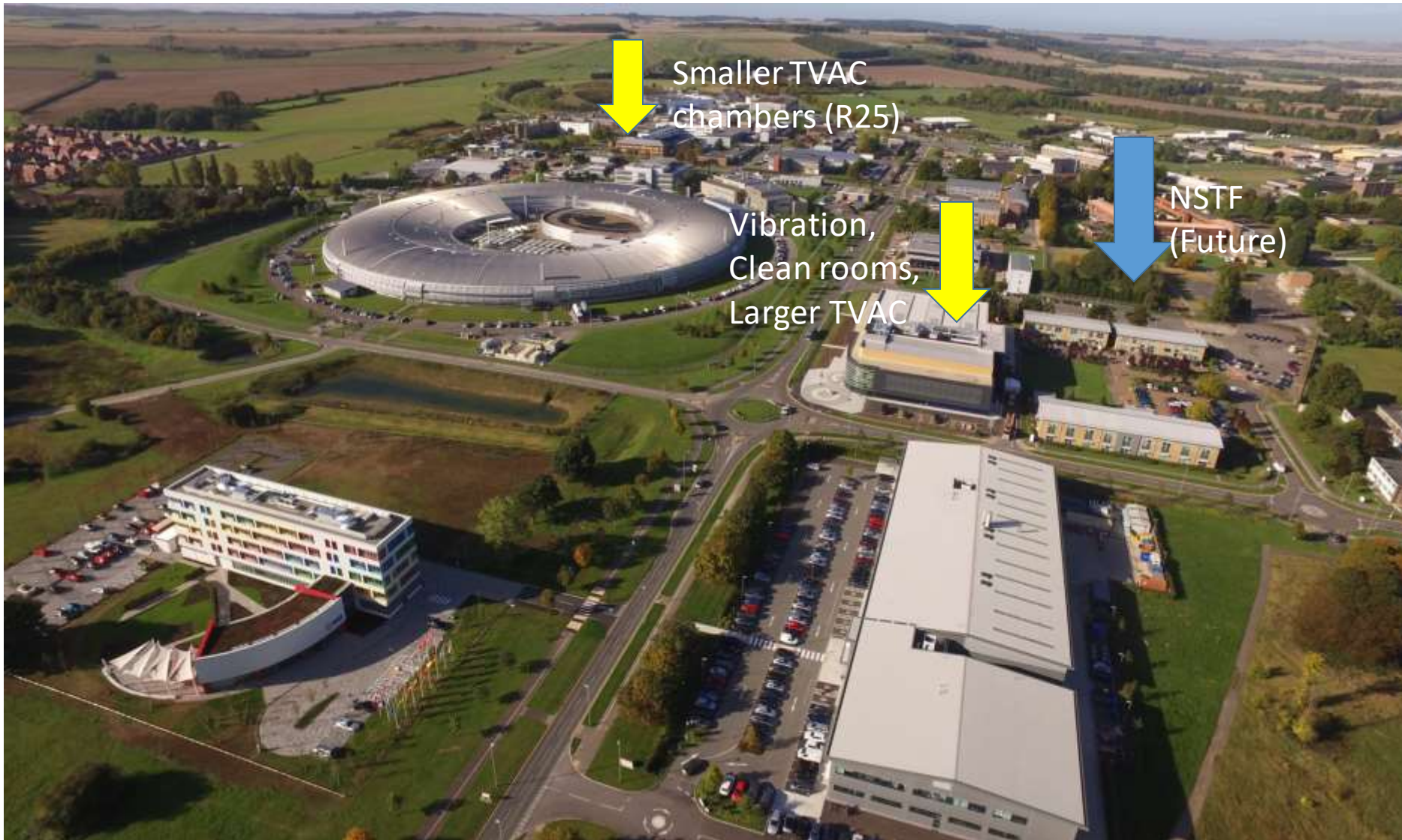
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Session Lead: Matt Fletcher

Satellite Hardware Testing Facilities (Meeting Point A)

Environmental Test Facilities



Vibration Test



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- Facility and operators to complete sine / random / shock testing
- 60kN shaker (57.8 sine, 66kN random)
- Large and small slip tables
 - 920 x 740mm
 - 1400 x 1250mm
- Range of head expanders / adaptors
- Up to 64 channels
- Typically costed per day

- Main Facility Contact: Dave Rippington/
Tom Lacey



- Range of TVAC test facilities
- Operated in clean conditions (ISO 5 / 6)
 - Humidity controlled
- Range of thermal environments, covering -190C to +150C
- Typically costed at facility day rate
 - Adaptions are fairly common
- Main Facility Contact: Sean Keen / Tom Lacey

<table border="1"> <thead> <tr> <th colspan="2">Chamber 1</th> </tr> </thead> <tbody> <tr> <td>Diameter</td> <td>0.6 m</td> </tr> <tr> <td>Length</td> <td>0.8 m</td> </tr> <tr> <td>Volume</td> <td>0.226 m³ 226 L</td> </tr> </tbody> </table> 	Chamber 1		Diameter	0.6 m	Length	0.8 m	Volume	0.226 m ³ 226 L	<table border="1"> <thead> <tr> <th colspan="2">Chamber 2</th> </tr> </thead> <tbody> <tr> <td>Diameter</td> <td>0.994 m</td> </tr> <tr> <td>Length</td> <td>1.69 m</td> </tr> <tr> <td>Volume</td> <td>1.312 m³ 1312 L</td> </tr> </tbody> </table> 	Chamber 2		Diameter	0.994 m	Length	1.69 m	Volume	1.312 m ³ 1312 L	<table border="1"> <thead> <tr> <th colspan="2">Chamber 4</th> </tr> </thead> <tbody> <tr> <td>Diameter</td> <td>1.07 m</td> </tr> <tr> <td>Length</td> <td>1.5 m</td> </tr> <tr> <td>Volume</td> <td>1.348 m³ 1348 L</td> </tr> </tbody> </table> 	Chamber 4		Diameter	1.07 m	Length	1.5 m	Volume	1.348 m ³ 1348 L		
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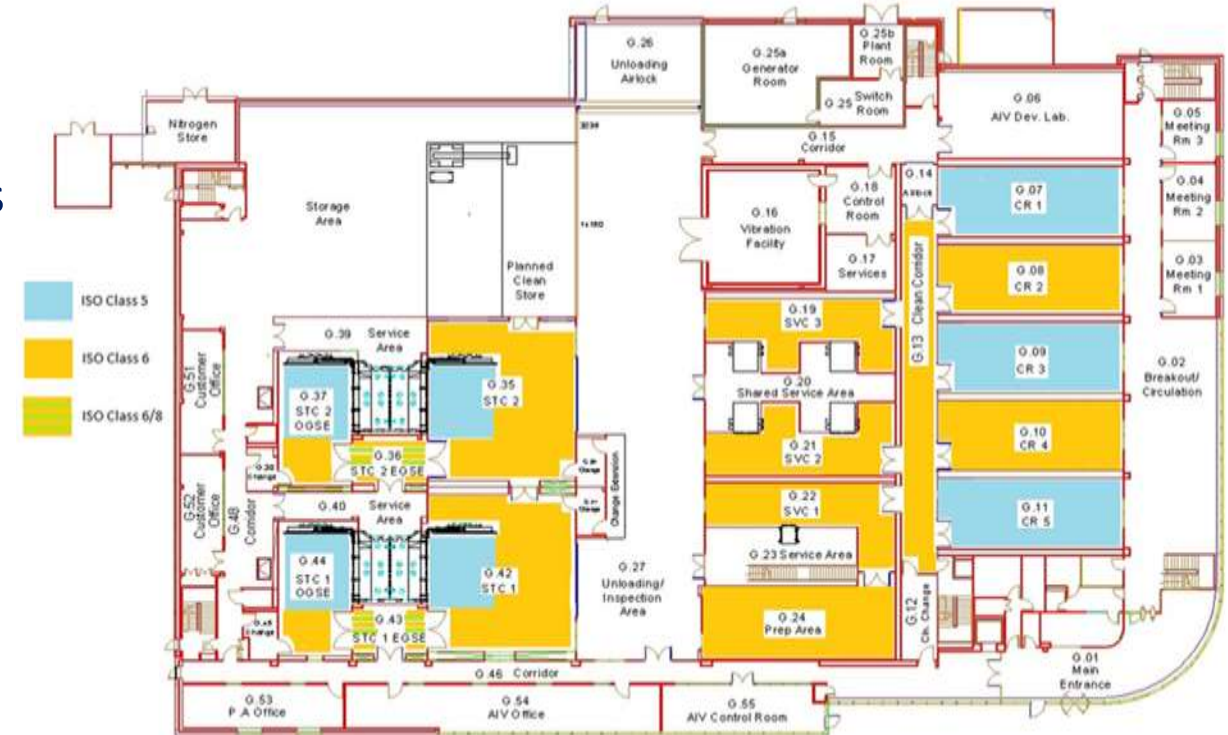
Clean Rooms



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- Provides monitored, controlled clean environment for build / integration – to ECSS-Q-ST-70-01C
- ISO 5 / 6 (Class 100 / 1,000) humidity controlled cleanrooms
- ESD dissipative floors
- Low reflectivity room with laser interlock
- Normally costed on monthly rental
 - Short term or long term available
- We provide
 - Gowning
 - training on clean room use
 - clean room cleaning
- Main Facility Contact: Giles Case / Tom Lacey



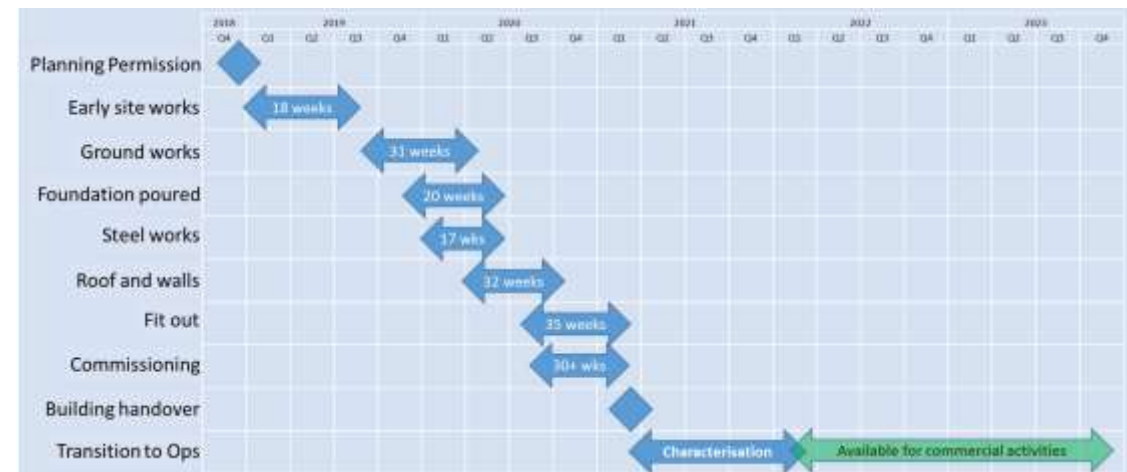
National Satellite Test Facility

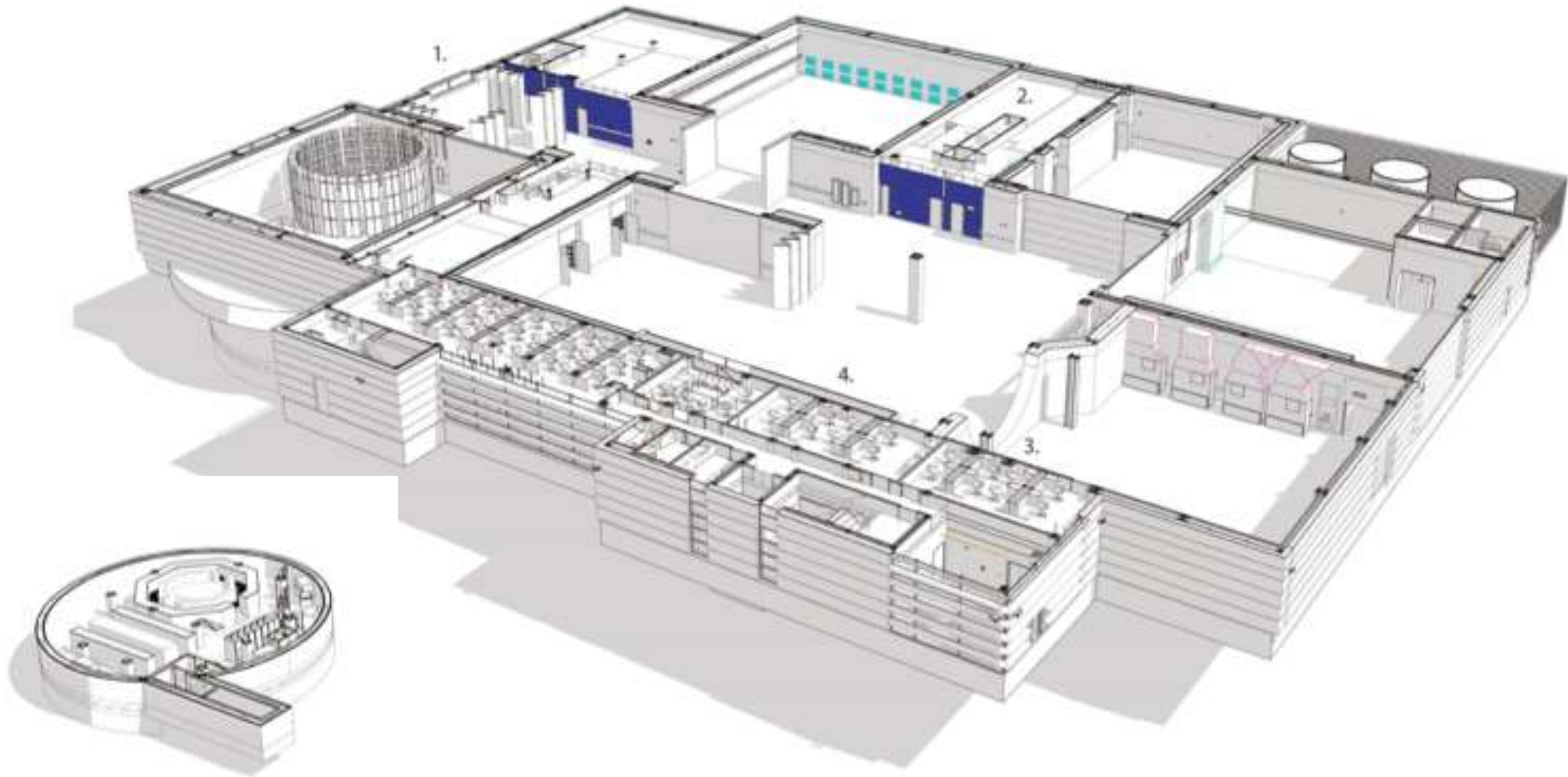


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- Purpose designed facility for payloads up to 7 tonnes
- Typically performed as a campaign
- Technical and commercial engagement prior to ITT
- Test Programme Manager
- Cost built up from facility use and campaign specific activities
- Handover from construction 2021, operational for test 2022
- Aiming for ECSS-Q-ST-20-07C Test centre certification from ESA
- Main Facility Contact: Matt Fletcher / Rob Elliott





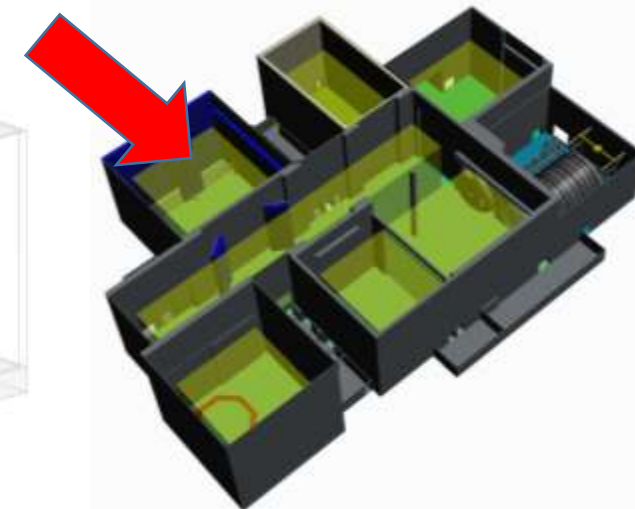
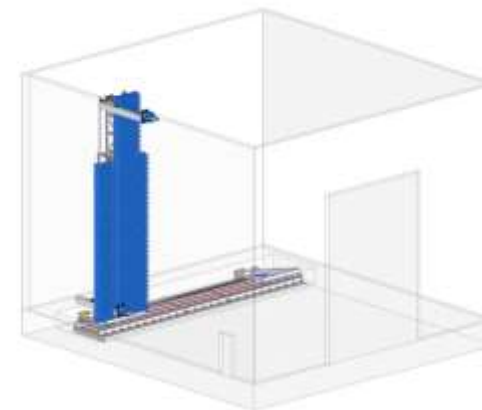
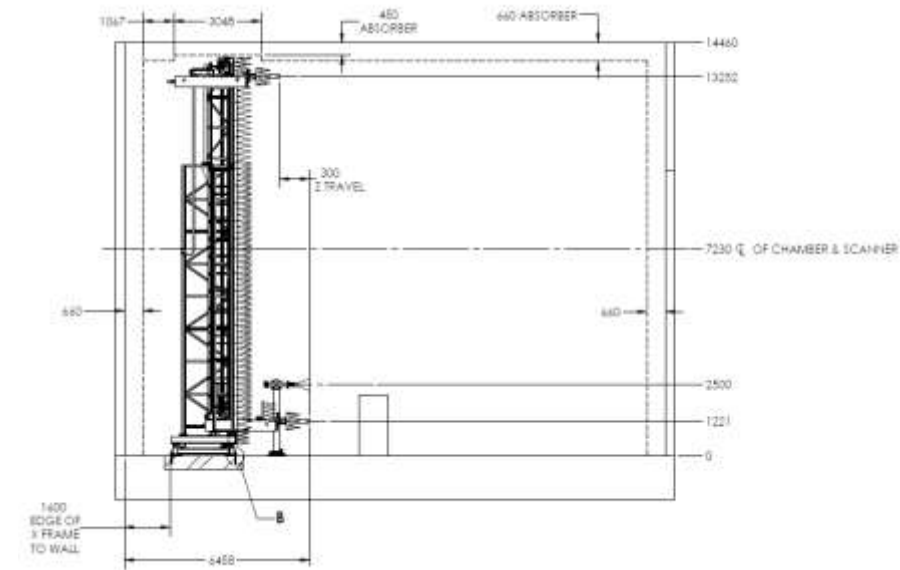
Antenna Measurement System



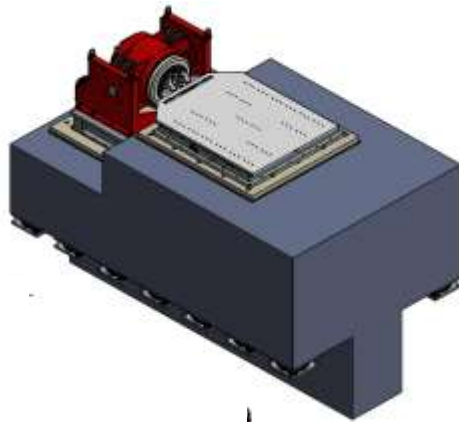
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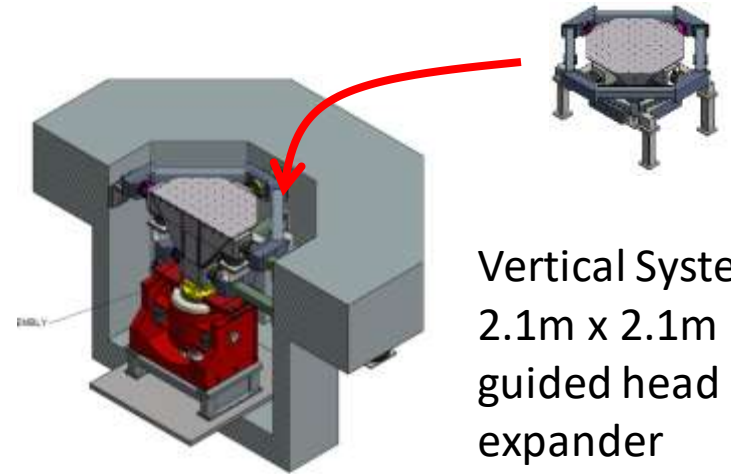
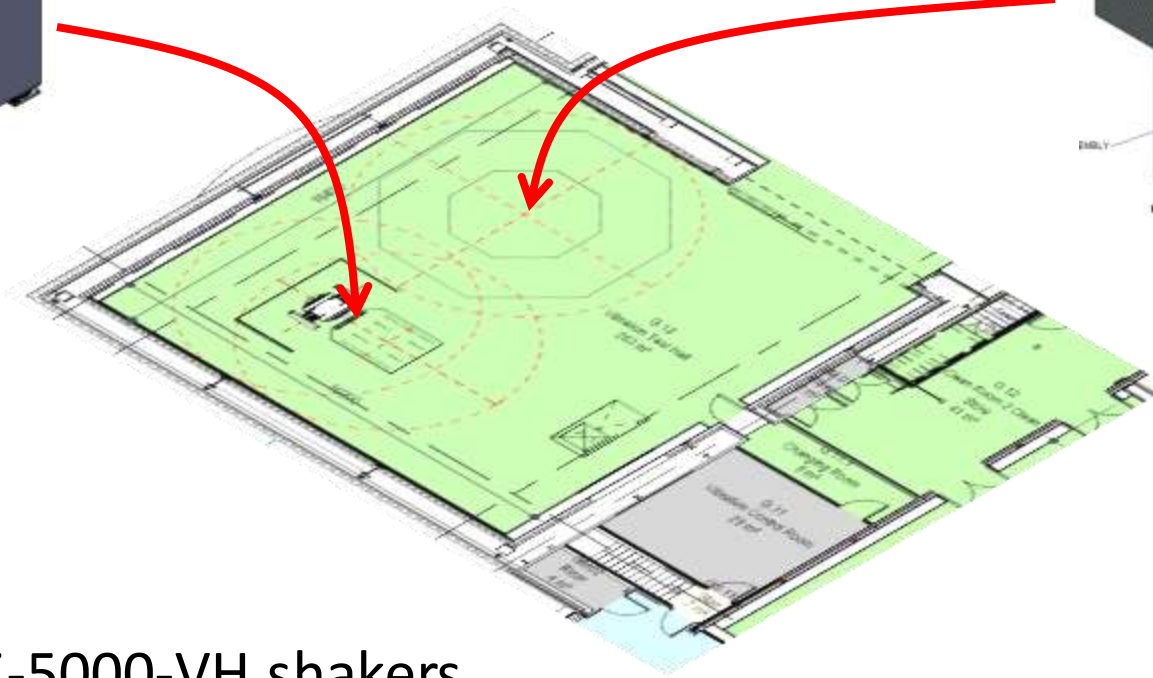
- ❖ 12m x 12m Vertical Planar Scanner
- ❖ Frequency coverage 500MHz – 75GHz
- ❖ Scanner aligned to centre of room to maximise scan area
- ❖ Internal usable space (tip to tip): 17.6m x 17.4m x 13.8m (LxWxH)
- ❖ Automatic large three leaf door: 7m x 10m (WxH) – clear access
- ❖ Level floor entry from access corridor into chamber
- ❖ Shielded EGSE room: 78m² (floor area)
- ❖ Shielded control room: 53m² (floor area)
- ❖ Radiated E-field testing up to 44GHz



Vibration (16m x 16m x 16m)

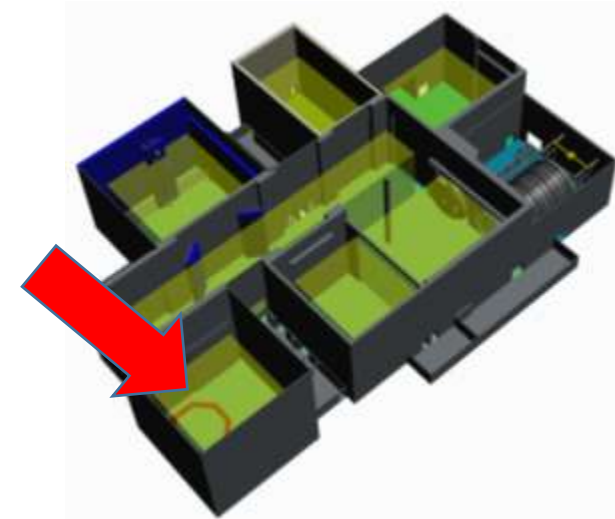


Horizontal System
2.1m x 2.1m slip
plate
205 tonne total mass



Vertical System
2.1m x 2.1m
guided head
expander
230 tonne total
mass

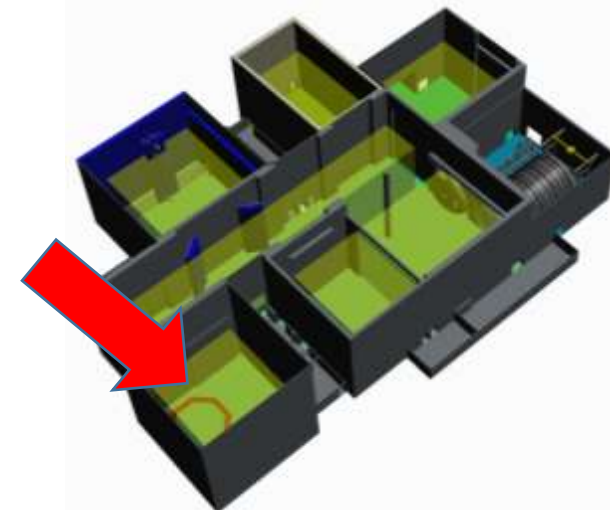
2 x DATA PHYSICS: LE-5000-VH shakers
222kN sine force, 3" stroke
Solid State Power Amplifier 360000 VA output
70 control channels (36 for force limiting), 500 data channels



Direct Field Acoustic Test

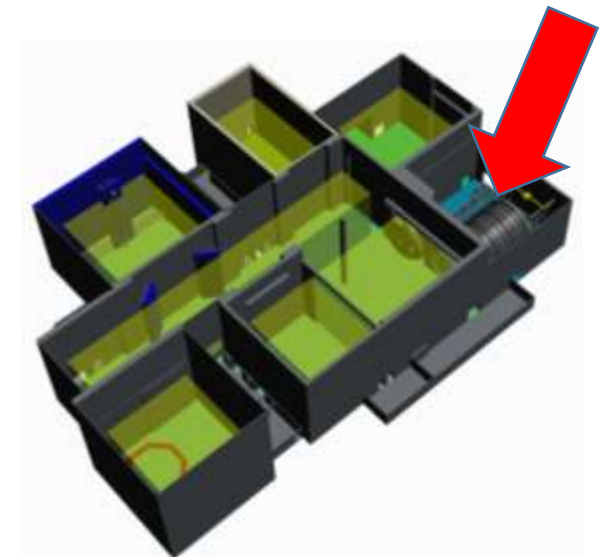
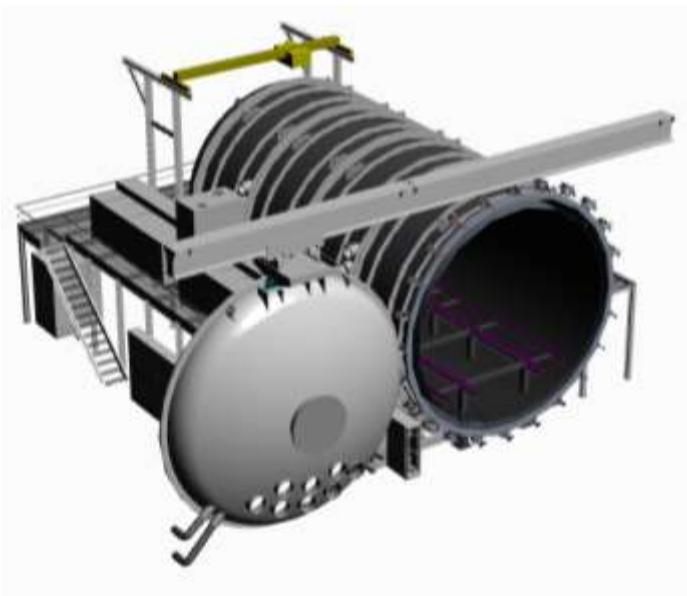


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Large Space Test Chamber

- $\varnothing 7$ m x 12 m usable length
- 95K – 400K
- ISO Class 8 clean



Payload Calibration Centre



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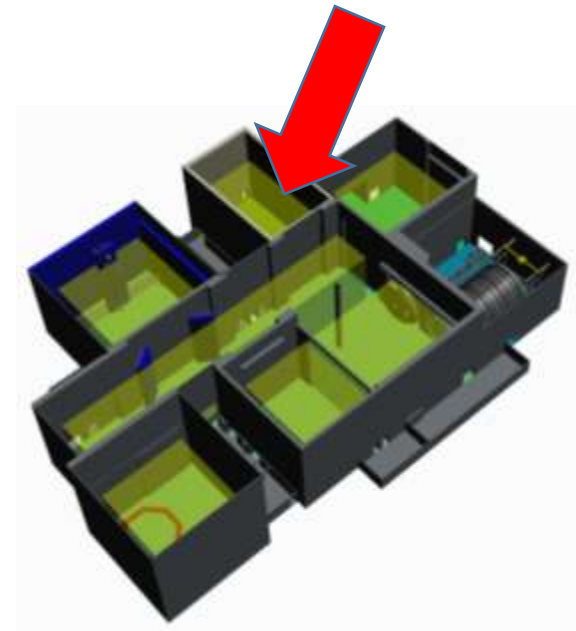
- RAL Space have over 25 years experience calibrating a range of optical sensors for earth observation and astronomy missions.
- Expertise includes
 - Development of ground and flight calibration sources operating in the visible to thermal infrared wavelengths to provide traceability to international standards.
 - Development of test facilities to support instrument pre-launch calibration
 - Planning and execution of pre-launch calibration campaigns
 - Analysis of test data to assess the performance of the instrument and to provide calibration data needed for data processing
 - Definition of processing algorithms necessary to convert raw instrument data to calibrated signals.
 - Analysis of in-flight data to calibrate operational data
- Current activities include:
 - Calibration of the Sea and Land Surface Temperature Radiometer for the Copernicus Sentinel-3 Mission.
 - Ground Blackbody Sources for the Meteosat Third Generation
 - Calibration subsystem for the Microcarb mission



Contact: **Dave Smith** – Radiometry Group Leader

Clean Rooms

- Majority of the space is ISO Class 8
- Separate clean room at ISO 6 or ISO 8
- Mass property measurement
- Pyroshock



Thankyou





Session Lead: Ed Jones

Manufacturing Facilities and Services (Meeting Point B)

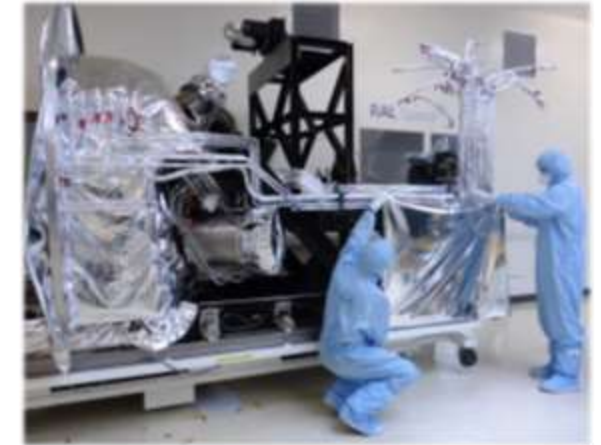
Multi-Layer Insulation Facility



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- With several years' experience, we are specialists in the design and manufacture of bespoke MLI, particularly for cryogenic or higher cleanliness applications. We offer the full range of MLI services, from initial conceptual design to manufacture and integration.
- Dedicated 90 m² ISO Class 7 cleanroom for manufacture and access to full suite of STFC test facilities
- Tailored proposal provided for each prospective project, based upon customer specific requirements. Support provided to both large and small customers equally.
- Recent Highlights:
 - James Webb Space Telescope – Mid-Infra Red Instrument
 - Sentinel 4 UVNS Mechanical Ground Support Equipment
 - OHB EnMAP Satellite and Hyper Spectral Imager Instrument



Contact: **Edward Jones** – MLI Facility Manager

Precision Development Facility



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- Expert in all aspects of precision machining and novel component prototyping.
- The PDF has made contributions to over 200 Space missions.
- Utilises state-of-the-art high performance CNC machines.
- Micron and nanometre tolerances.
- Access available, costed on individual basis.
- Facility Contact: Mat Beardsley



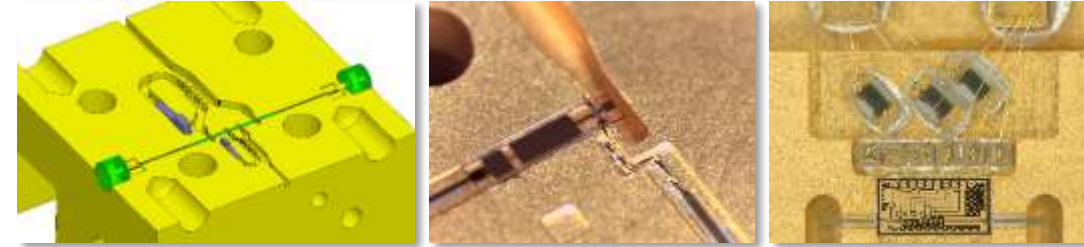
MM-wave Technology



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- World-leading high frequency sensor development (up to 5THz) with ultra-high spectral resolution ($\sim 1\text{MHz}$).
- Rare mix of design and space qual. component fab. & assembly/systems development/testing.
- Extensive range of high-frequency design, test and measurement facilities (phase and mag. to $\sim 1\text{THz}$).
- Approx. 45 staff with extensive experience.
- Collaborative R&D, consultancy, direct supply on a per project FEC basis.
- Project: MetOp-SG, ALMA, Marschals, UARS MLS...
- Main Facility Contact: Prof. Brian Ellison



Device Design and Space Qualified Fabrication



Space Approved Assembly and Test Facilities

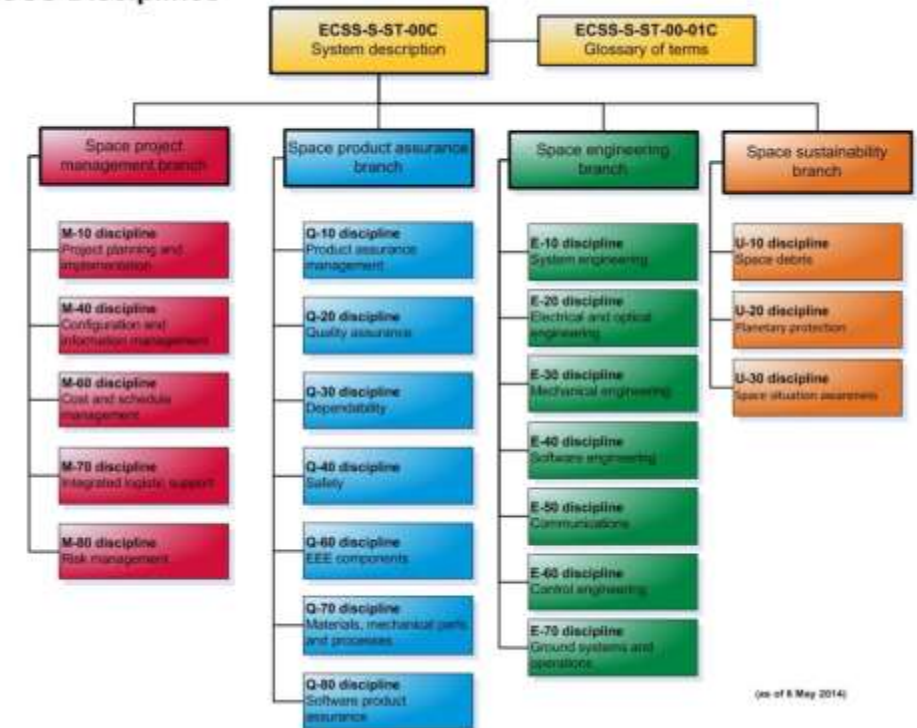


Bespoke State-of-the-art Devices and Systems



- Provision of Product Assurance support
 - Enabling compliance with customer PA and QA requirements (ECSS)
- Team of PA specialists with diverse experience and knowledge
 - Electronics engineering, Precision manufacturing, Mechanical engineering, Materials science, Software engineering, Planetary protection
- Provides Product Assurance Management function to RAL Space projects
 - Team members serve in the PA Manager role on projects
 - Well-established processes supported by a library of standard forms and template documents
 - Administer RAL Space instance of Sapienza Eclipse tool suite for document and non-conformance management
- Track record supporting work for programmes from ESA, EUMETSAT, NASA
 - EarthCARE, Meteosat Second Generation, Meteosat Third Generation, MetOp Second Generation, Solar Orbiter, ...
 - JWST, GOES, SDO, ...
- Available to provide support or consultancy to companies not (yet) able to provide the PA function in-house
 - Staff time charged at hourly rates, typically as a call-off from an agreed maximum commitment
 - Could provide access to Sapienza Eclipse suite (DCCM, eNCTS) at a per user/per module rate
- Contact: Richard Stamper

ECSS Disciplines





Session Lead: Rain Irshad

Scientific Facilities (Meeting Point C)

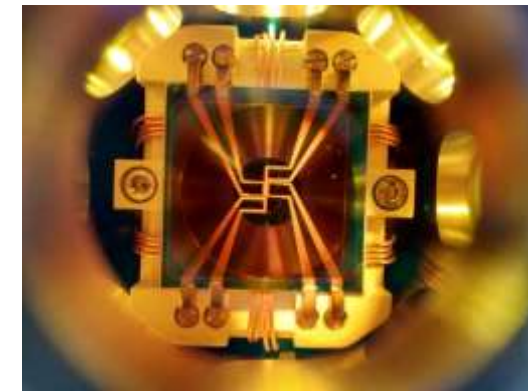
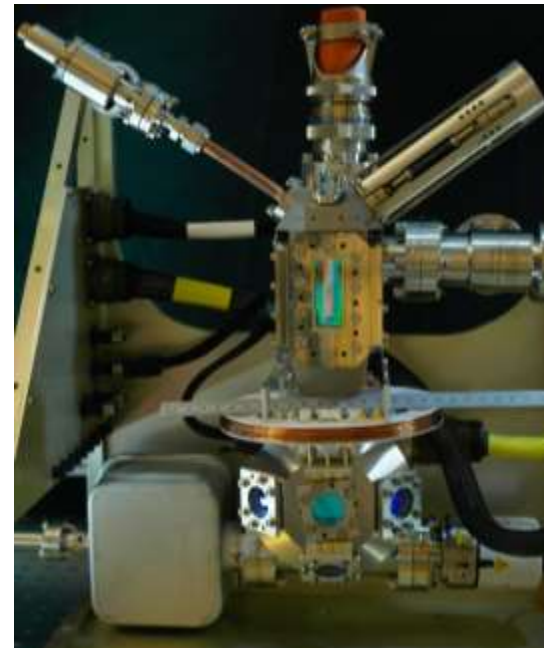
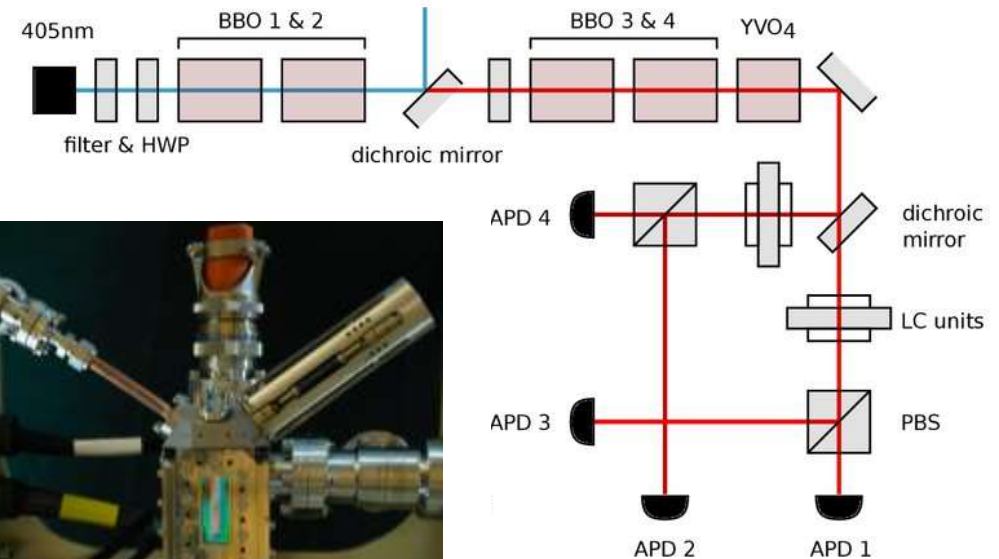
Quantum Space Laboratory



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- Help in developing and space qualifying Quantum Technologies, icw the Quantum Comms Hub (U. of York)
- Access to technology experts and facilities (opto-electronics fab & test) on site and around the UK, inc. the RAL Space Cold Atom group
- Will soon include an Optical Ground Station facility at Chilbolton.
- Collaborative role, through the UK QT programme or other funding routes, or consultancy (Innovate/ARTES or private funding)

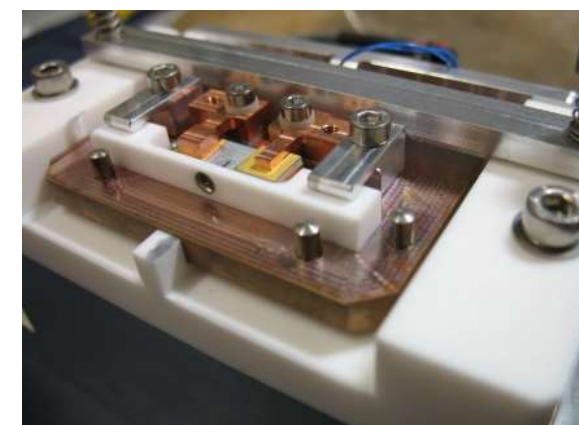
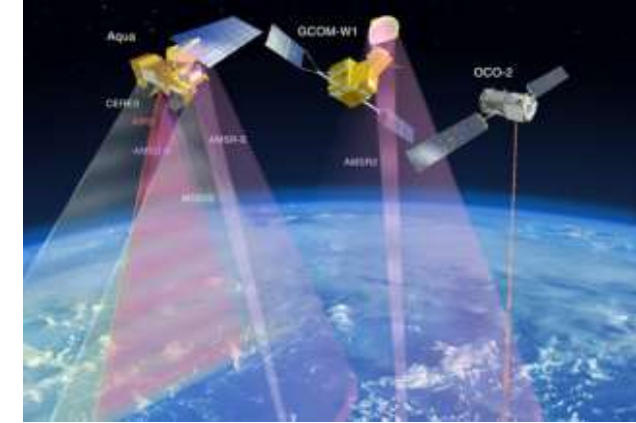


Contacts:

QSL: Andy Vick

Cold Atoms: Tristan Valenzuela

- Expertise in trace gas sensing using high resolution spectroscopy
 - In-situ and remote sensing, active and passive
 - Sensing system and scenario modelling and analysis
 - Instrument development
 - Instrument campaign deployment (e.g. ground truthing)
- Unique UK expertise in mid IR laser sensing systems
 - Laser gas sensor technology developments
 - Application developments
 - Photonics systems and miniaturization
- Optical labs, IR photonics equipment, highly skilled scientists
- Collaborative R&D, commercial R&D contracts
- Contact: D
- Damien Weidmann
- <https://www.ralspace.stfc.ac.uk/Pages/Spectroscopy.aspx>



Hi-Res Spectroscopy Facility



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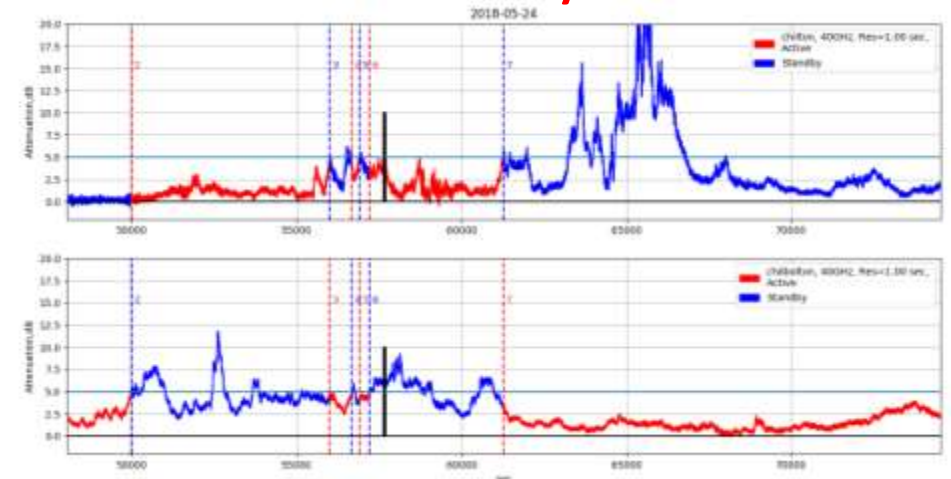


- Provision of high resolution reference spectral data
 - Reference laboratory spectroscopy (e.g. data processor enhancement)
 - Reference atmospheric spectroscopy (e.g. validation)
 - Spectral calibration, independent validation
- National facility for laboratory spectroscopy
 - 2x largest commercial FTIR (Bruker IFS125HR)
 - UV to mmWave coverage with ultra-high resolution
 - Absorption, emission, reflection
 - Gas, aerosols, liquids, solids
 - Spectral analysis
- Gas handling equipment, high precision heliostat, spectral data interpretation and algorithms, skilled experts
- Collaborative R&D, commercial R&D contracts, facility access costed per week
- Contact: Damien Weidmann
- <https://www.ralspace.stfc.ac.uk/Pages/High-Resolution-Spectroscopy-Facility.aspx>



- Experts in Radio Channel assessment for Earth-Space telecoms and EO Data Downlink systems.
- Leading role to all major radio propagation activities and studies in Europe (currently is leading the ALPHSAT campaign)
- A reliable growing database of measurements spanning from Ku-band (12GHz) to Q/V-band(40/50GHz).
- In house software tool, using this database, for the emulation of Earth-Space system under real conditions.
- Access available, costed on individual basis.
- Facility Contact: Spiros Ventouras

Emulation of High Throughput Satellite System





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Session Lead: Rain Irshad

Space Systems Design Facilities (Meeting Point D)

Space Systems Design Facilities



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❖ Electronics Design & Assembly Facilities:

- ❖ Specialise in complex multi-layer designs for hi-rel applications

❖ Design:

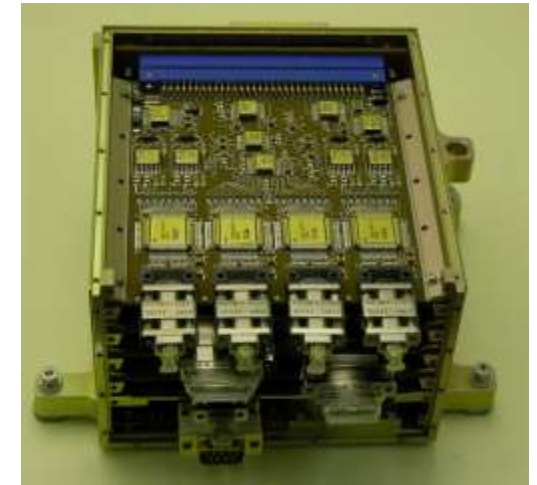
- ❖ Electronics Design & Analysis:
 - ❖ Schematic Capture, PCB Design, Simulation, Circuit Board Analysis, Data Analysis
- ❖ Software Design:
 - ❖ Instrument control and data analysis in C, C++ and IDL

❖ Assembly:

- ❖ 4 x ISO 14644-1:2015 Class 7 Cleanroom assembly facilities:
 - ❖ Flight assembly
 - ❖ Semi-auto pick and place and vapour phase soldering
 - ❖ Conformal coating facility
 - ❖ Cleaning and processing

❖ Test:

- ❖ 2 x Test Laboratories (including 1 cleanroom) + further 3 that may be used as a cleanroom or laboratory space



❖ Optics Design & Assembly Facilities:

❖ Design:

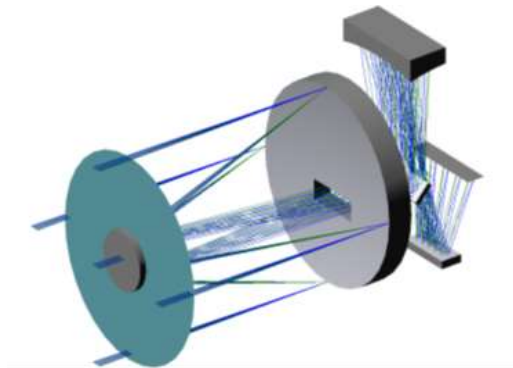
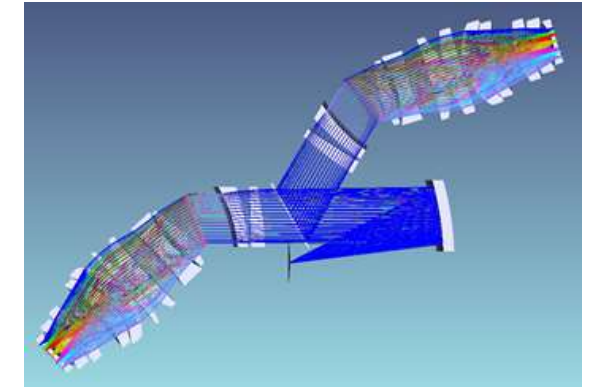
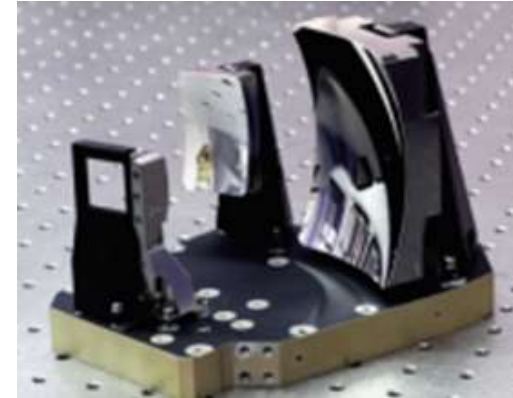
- ❖ Optical systems design (EUV to THz)
- ❖ Optical engineering
- ❖ Systems engineering
- ❖ Stray light analysis and control
- ❖ Industry standard tools (CodeV, Zemax, ASAP etc)

❖ Assembly:

- ❖ Assembly, alignment and test

❖ Test:

- ❖ Testing capability including black cleanroom



❖ Benefits:

- ❖ Bespoke system design and engineering of electronics, optics and sensors
- ❖ State of the art facilities for full product lifecycle
- ❖ ESA certified operators and inspectors
- ❖ Extensive flight heritage

❖ Examples of projects:

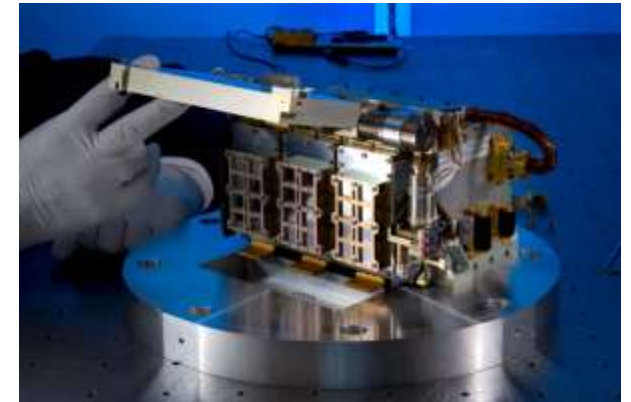
- ❖ D-CIXS and C1XS, Stereo, Solar Dynamics Observatory, GOES-16, Rosetta-Ptolemy, WSO WUVS, WEAVE, Urthecast, ExoMars

❖ Engaging with us:

- ❖ Strategic partnerships,
- ❖ Teaming and Individual opportunity collaboration
- ❖ Commercial business partner

❖ Contacts:

- ❖ Electronics - Chris Howe:
- ❖ Optics – Ian Tosh



Space Systems Design Facilities



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❖ **Concurrent Design Facility:**

❖ Dedicated room to enable Concurrent Engineering:

- ❖ Typically used by a project team twice a week for a few weeks to iterate a study
- ❖ Colocation of team + efficient sharing of data allows a system in flux to be bottomed out to a solution during study.

❖ 14 dedicated PCs + 4 laptop spaces + video con:

- ❖ Two PCs are higher spec to allow CAD + ESATAN to be run efficiently.

❖ Matrix display allows any PC's screen to be shown on large screens at front:

- ❖ Ideal for presentations of work in progress

❖ Uses Rhea's client + server software for sharing of the study data:

- ❖ Same as used by ESA in their CDF at ESTEC

❖ Also a Mission Operation Centre:

- ❖ UKSA funded
- ❖ Used for Airbus rover trials

❖ Contacts

- ❖ RALSpaceCDF@stfc.ac.uk



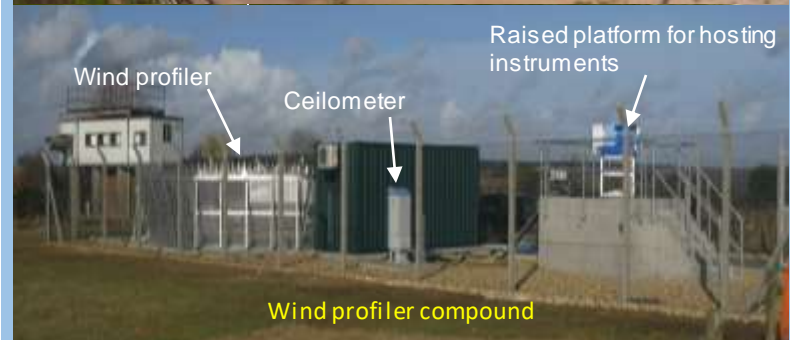


Session Lead: Brian Ellison

Ground Segment & Operations Facilities (Meeting Point E)

Chilbolton Observatory

- Atmospheric propagation studies via active (radar) and passive sounding to 200GHz.
- Supporting satellite communications and data downlinks for UK businesses.
- Supporting guest observation facilities (e.g. Defra)
- Sole UK site for the LOFAR radio astronomy telescope.

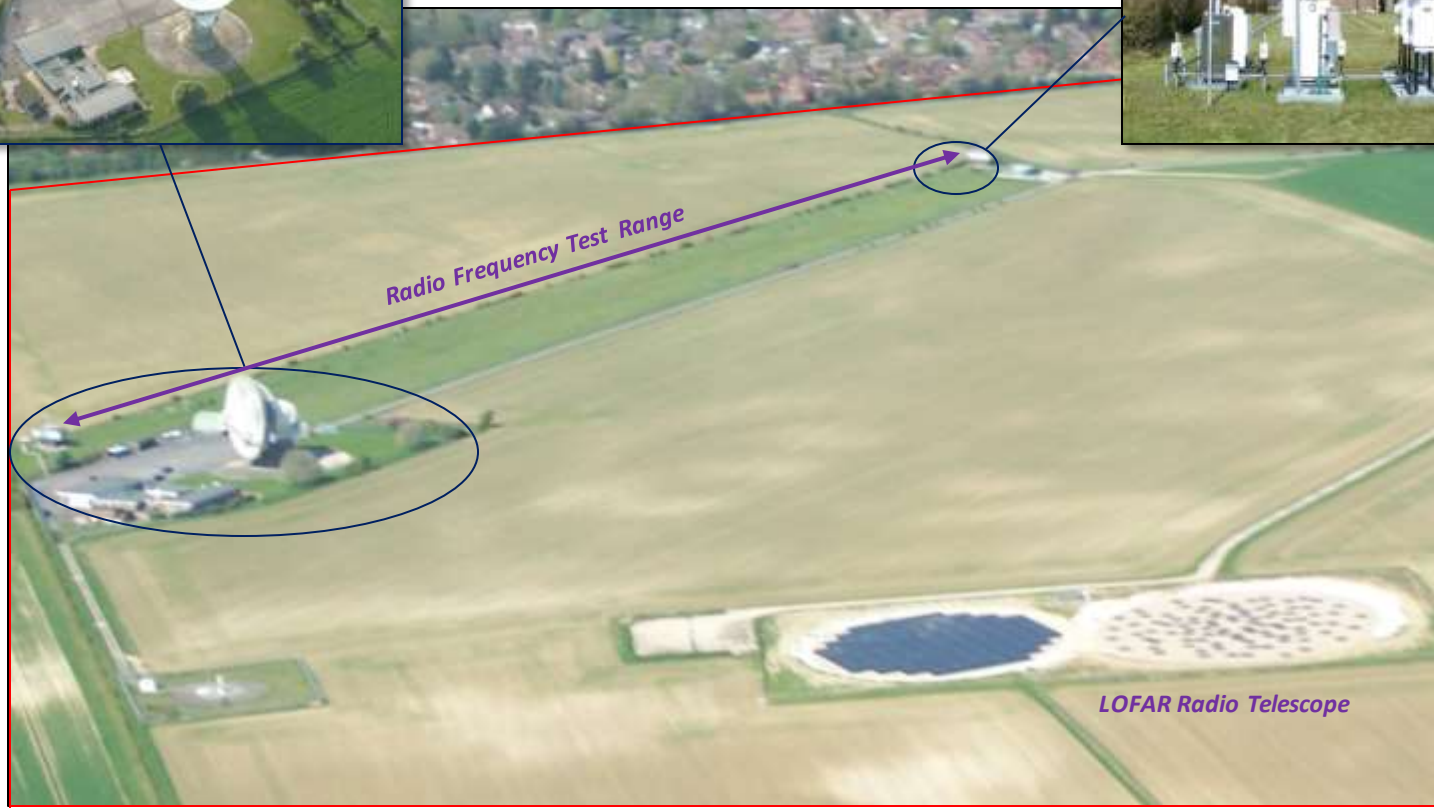


Chilbolton Observatory

25m Dia. Antenna, Control Buildings and Support Labs



Defra/EA Air Quality Monitoring Site



Multi-acre rural site with a range of existing facilities supporting atmospheric studies and radio astronomy research

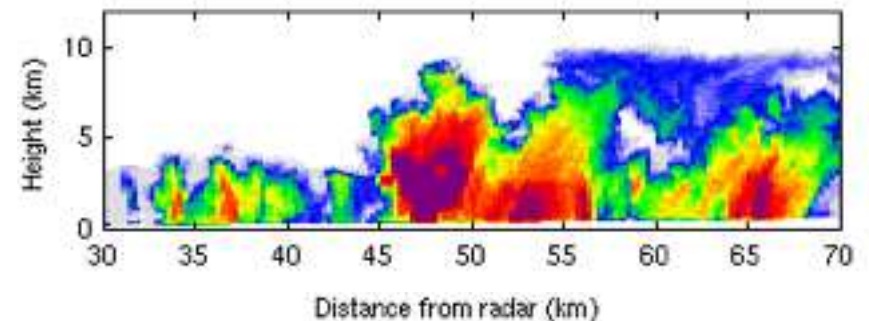
Chilbolton Facility



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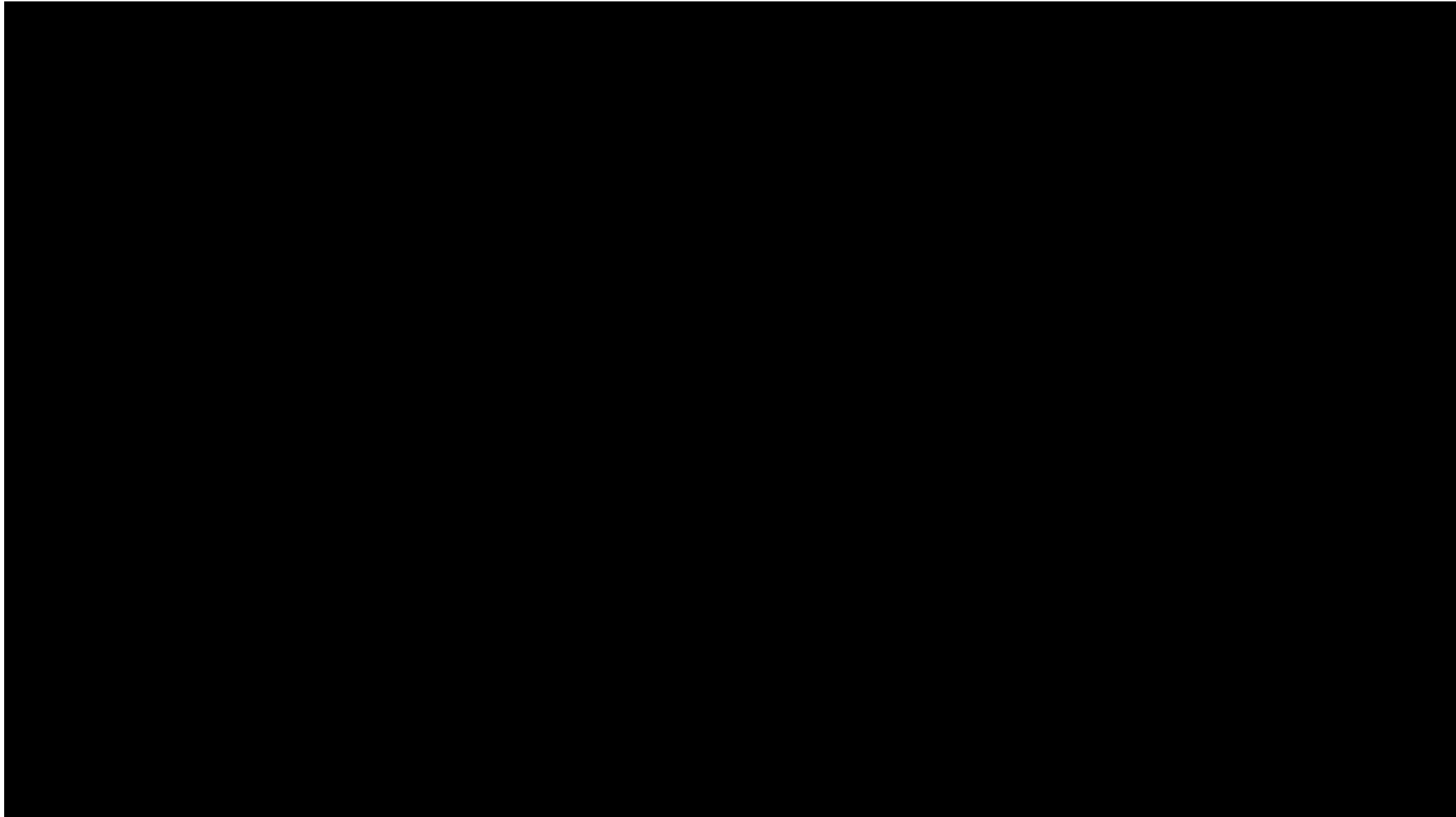
- Opportunities for field testing and cal/val activities using quality controlled atmospheric observations.
- Unparalleled high-resolution steerable meteorological radar (3GHz + planned 9GHz) on 25m antenna, plus polarimetric Doppler cloud radars (35, 94 and 200GHz).
- Unique combination of atmospheric in-situ and remote sensing facilities - scope for hosting guest instruments.
- Quality assured measurements of clouds, precipitation, aerosols and boundary layer meteorology, with user defined radar operations for case studies.
- Costing through collaborative R&D and FEC projects.
- Main Contacts: Prof. Brian Ellison and Dr Chris Walden - group and NFARR respectively, Darcy Ladd @ Chilbolton.



Chilbolton Facility



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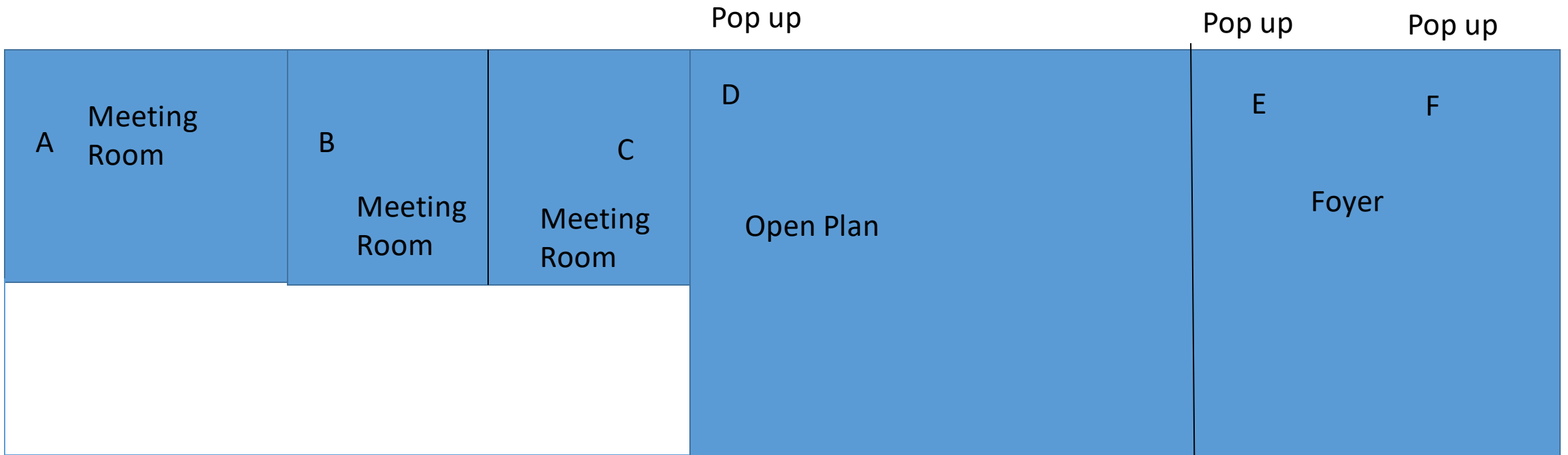
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Thank You!

Lunch & 1-2-1 Sessions

1-2-1 Session Meeting Points





Laboratory Tours

Safe Journey Home



All enquiries



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- Please direct all enquiries to
- Robert Elliott, Head of Business Development
- robert.elliott@stfc.ac.uk
- 01235 446453