Science & Technology Facilities Council | UK Research and Innovation

RAL Space

Millimetre/Submillimetre-Wave Engineering at Rutherford Appleton Lab.

Millimetre-wave Technology (MMT) &
Chilbolton Radio Group

Prof. Brian Ellison, Group Leader

millimetre-wave technology MMT

MMT & Chilbolton Background

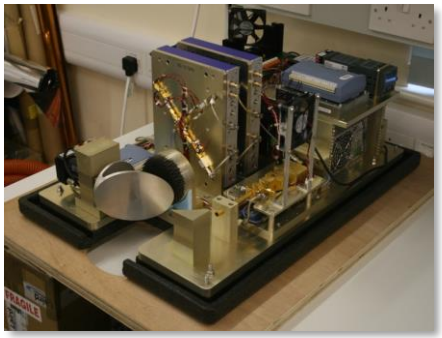
millimetre-wave technology
MMT

- Approx. 45 staff supporting MM/Submm-wave R&D.
- Extensive high-res. heterodyne receiver development experience.
- Passive and active sounding from ground, air & space.
- Supporting astronomy (e.g. ALMA) and Earth observation (e.g. MetOp) science.
- Host site for LOFAR UK.

ALMA Receiver Integration & Test

500GHz JCMT SIS Receiver

MM-wave Photomixer Production for ALMA



Compact Turn-Key THz Receiver System

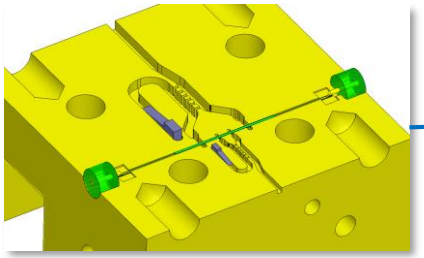
LOFAR at Chilbolton

Chilbolton 25m Radar

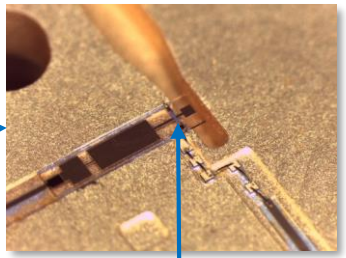
MM/Submm-Wave Engineering

millimetre-wave technology
MMT

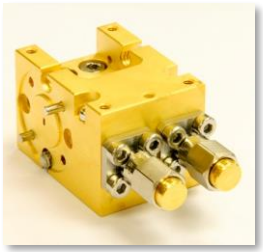
- High frequency sensor and systems development to 5THz.
- Design, component fab. and systems development/assembly inc. spaceflight.
- Super/semiconductor Rx development.
- Schottky barrier diode foundry.
- Ultra-high precision manufacture.
- Micro/mm-wave test facilities.

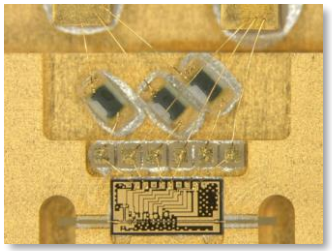


Device Design

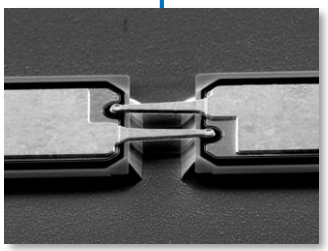


Fabrication

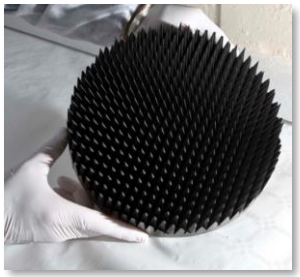




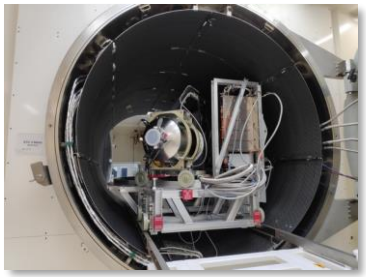
Micro-miniature Assembly



Semiconductor Diode Fab.



Calibration Targets



THz Thermal-Vac. Calibration Rig

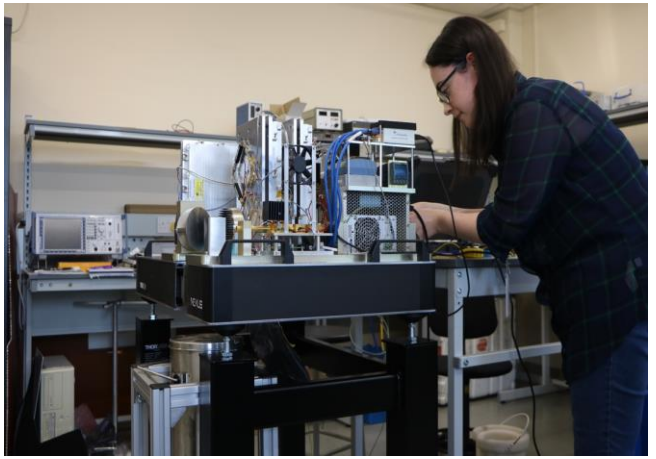
Clean Room Facilities

Precision Manufacture

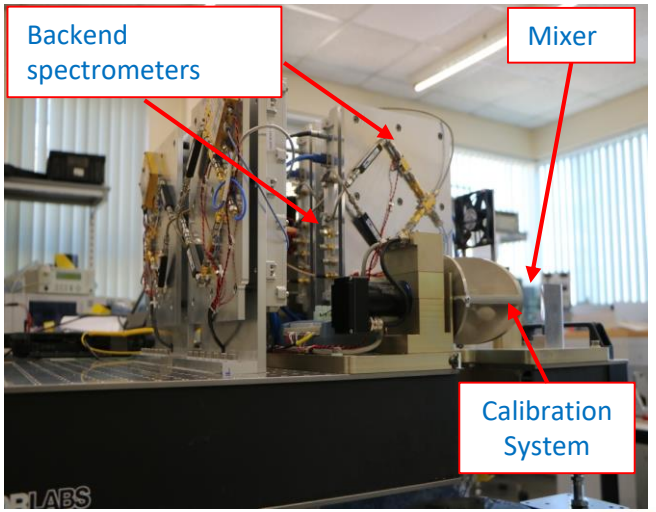
Recent Astronomy System Example

millimetre-wave technology
MMT

- CHARM - Collaborative Heterodyne Astronomical Receiver for Mexico.
- STFC Global Challenge Research Fund Project.
- 350GHz heterodyne system for use at the Large Millimeter Telescope, Mexico.
- Compact, fully integrated ‘turn-key’, room temperature double sideband receiver.
- Uses RAL Schottky diode mixer technology.
- Four 2GHz FFTS systems providing 8GHz bandwidth/sideband @ ~1MHz res.
- University of Manchester, PI, with National Institute of Astrophysics, Optics and Electronics, Mexico collaboration.
- RAL team now installing as I speak.



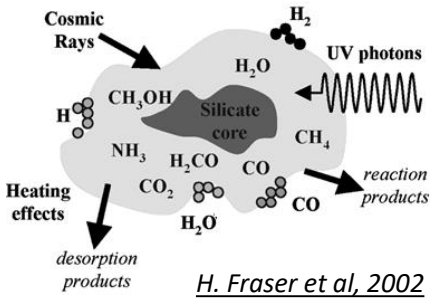
CHARM receiver system in preparation



THz Laboratory Spectroscopy

millimetre-wave technology MMT

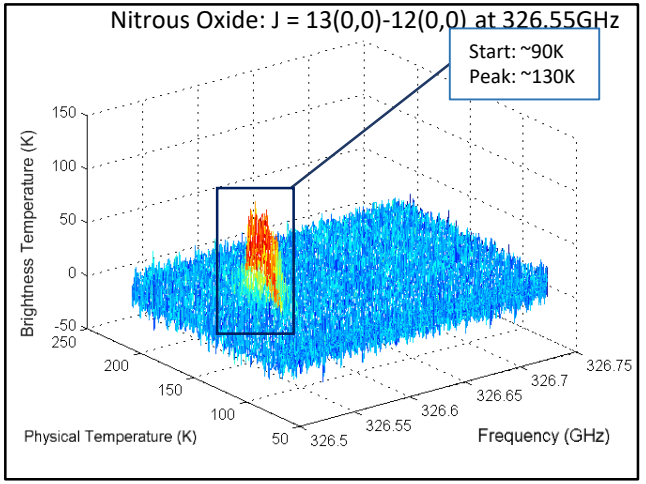
- THzDES – THz desorption study of processes involved during star formation.
- Collaboration between the Open University and RAL.

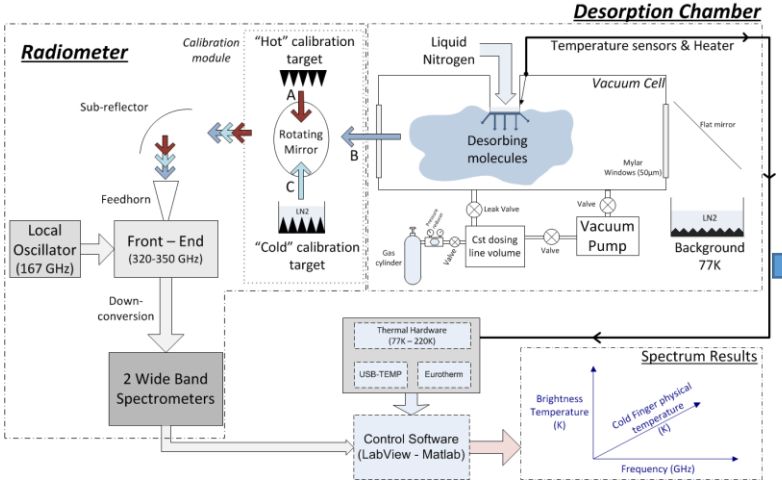


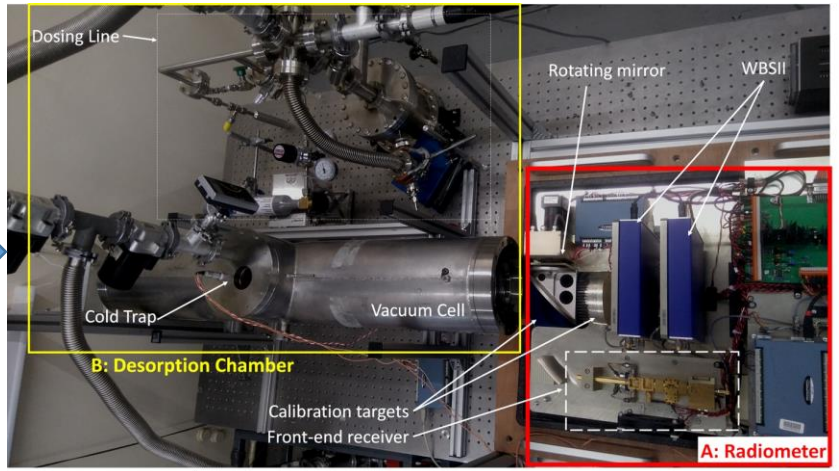
H. Fraser et al, 2002

Example Target Molecules

Molecule	Frequency (GHz)
N_2O	326.556
H_2O	325.153
CH_3OH	326.631
CH_3OH	342.730
CH_3OH	344.109
CH_3OH	344.312
CH_3OH	344.443
CH_3OH	345.904





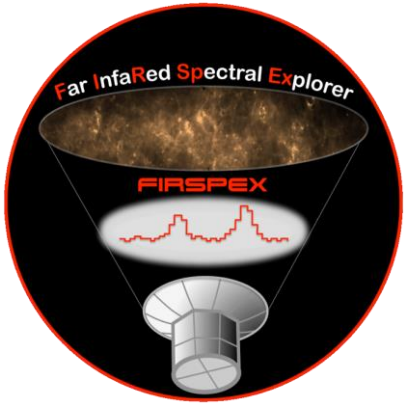


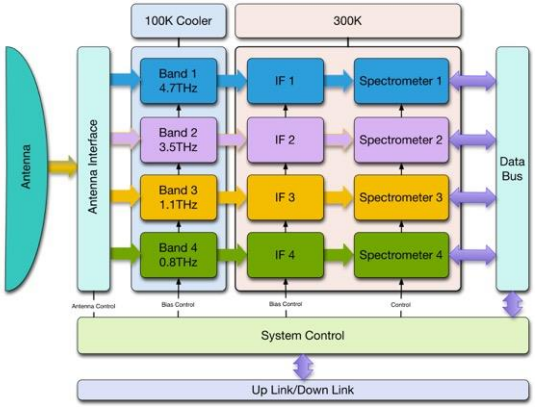
RAL & Open University Proof of Concept System

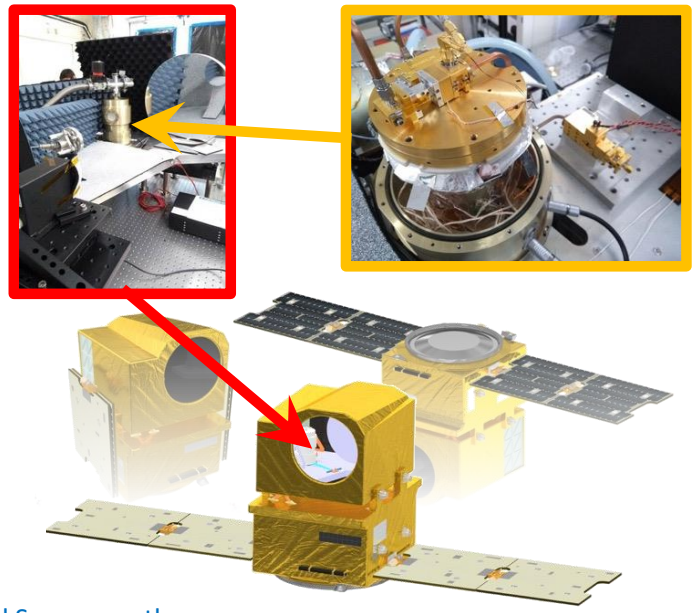
Multi-THz Sounder for Space

millimetre-wave technology
MMT

- THz Schottky diode mixers and quantum cascade laser front-end.
- High res. spectrometer backend.
- Compact small satellite payload for astronomy and/or Earth obs.

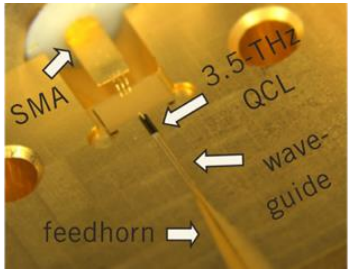


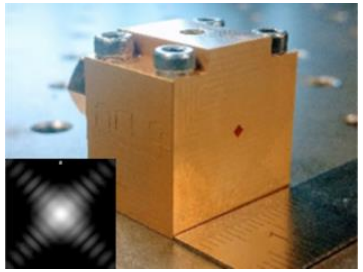




LOCUS Concept: Linking Observations of Climate, the Upper-atmosphere and Space-weather

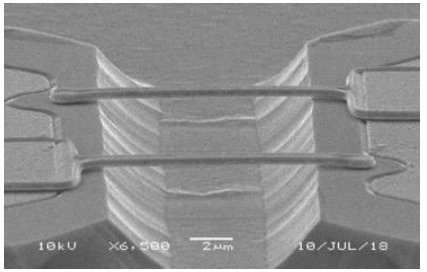
Quantum Cascade Laser (QCL) devices as a high-power source to pump heterodyne Schottky mixers





Miniature space coolers to provide QCL cooling (~70K) RAL Tech Dept.

RAL Space Schottky Barrier Diode Typically < 1µm dia. anodes



Compact, high-speed, power efficient digital spectrometers

Summary

millimetre-wave technology
MMT

- RAL supports mm/submm-wave astronomy.
- We have substantial relevant technical capabilities.
- Extensive astronomy collaborations, *e.g. Manchester, Leeds, Open University, QUB, Oxford and Cambridge, and international partners, e.g. INAOE, IRAM, Chalmers, LERMA, Smithsonian, INAF, ESO…*
- Keen to explore new collaborative possibilities.

Thanks for listening.