IsoLab at Lancaster University

20th March 2024

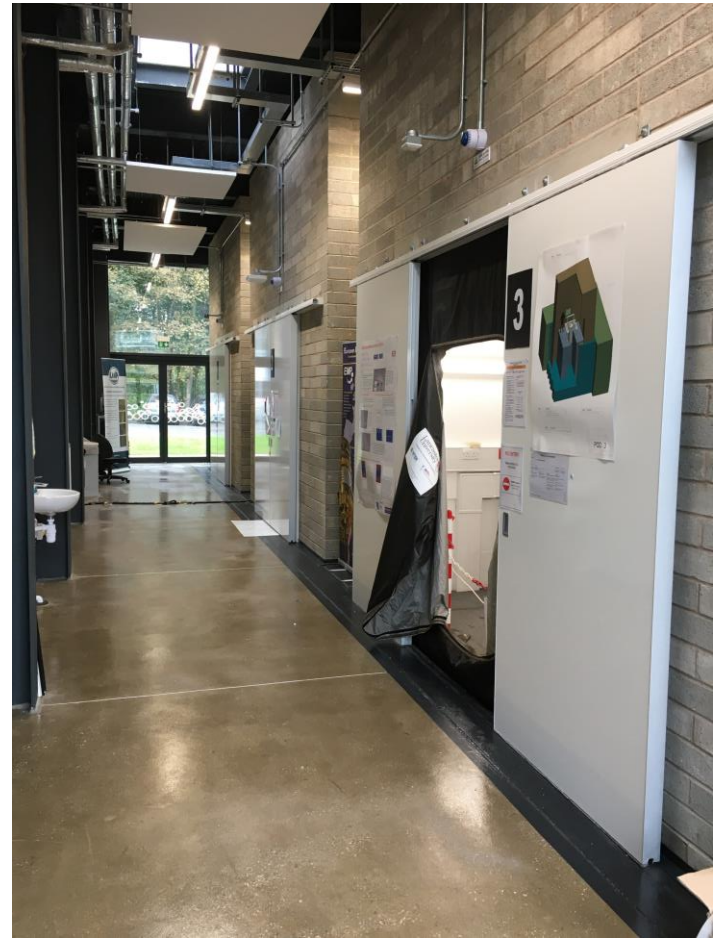
Jonathan Prance

Three isolation laboratories

The building hosts three independent laboratory “pods” with

- vibration isolation,
- electromagnetic shielding,
- filtered electrical supplies with separated grounds.

The labs support a range of activity in the general areas of quantum technology and nanoscience.



Based on existing knowledge and expertise

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- IsoLab is based on decades of experience building isolated environments for ultralow temperature physics.
  The goal: sustained microkelvin temperatures in superfluid helium.

- Through vibration isolation and electromagnetic shielding, the residual heat leak is consistent with radiogenic background of the fridge and surroundings.

Based on existing knowledge and expertise

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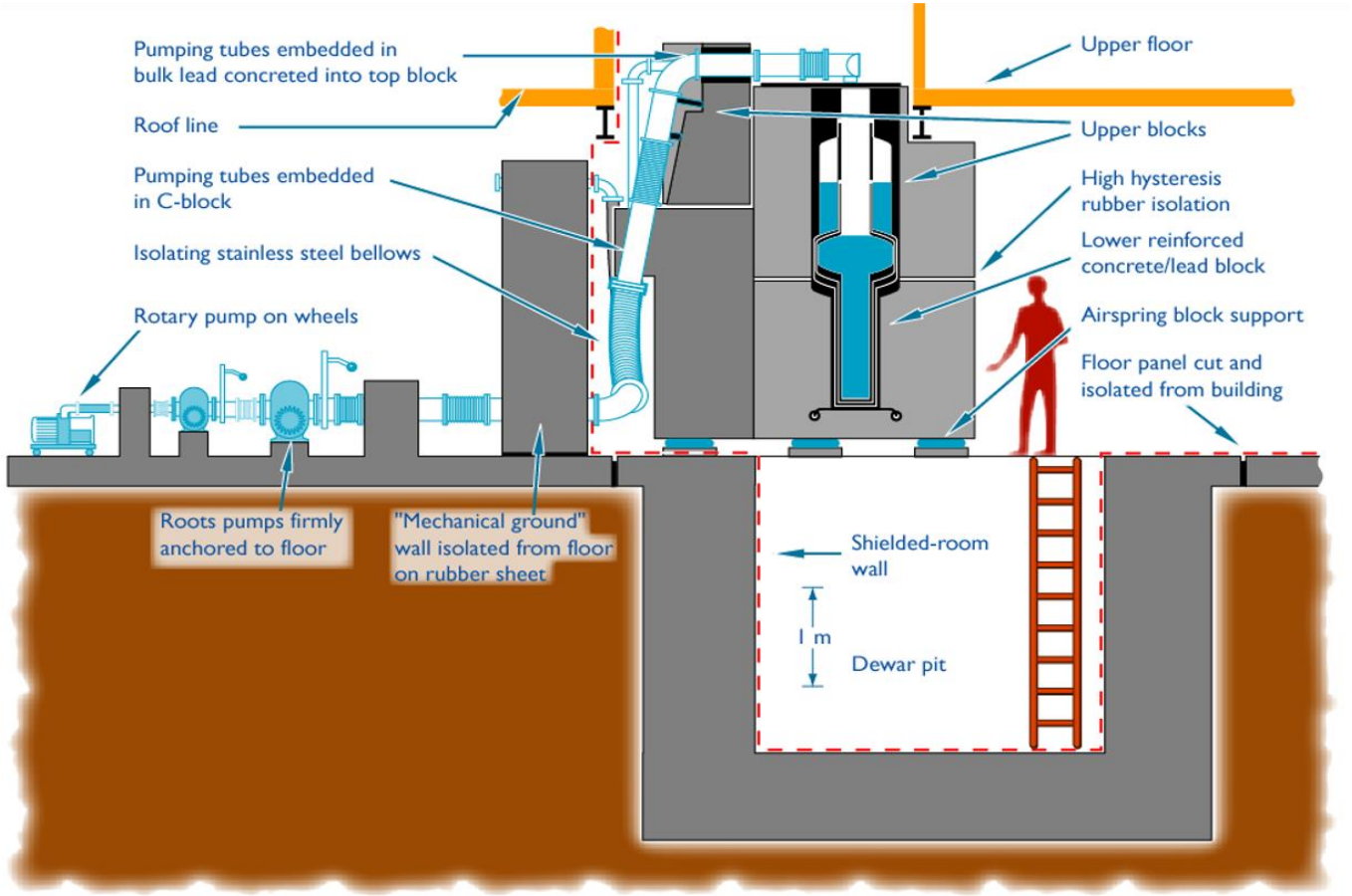
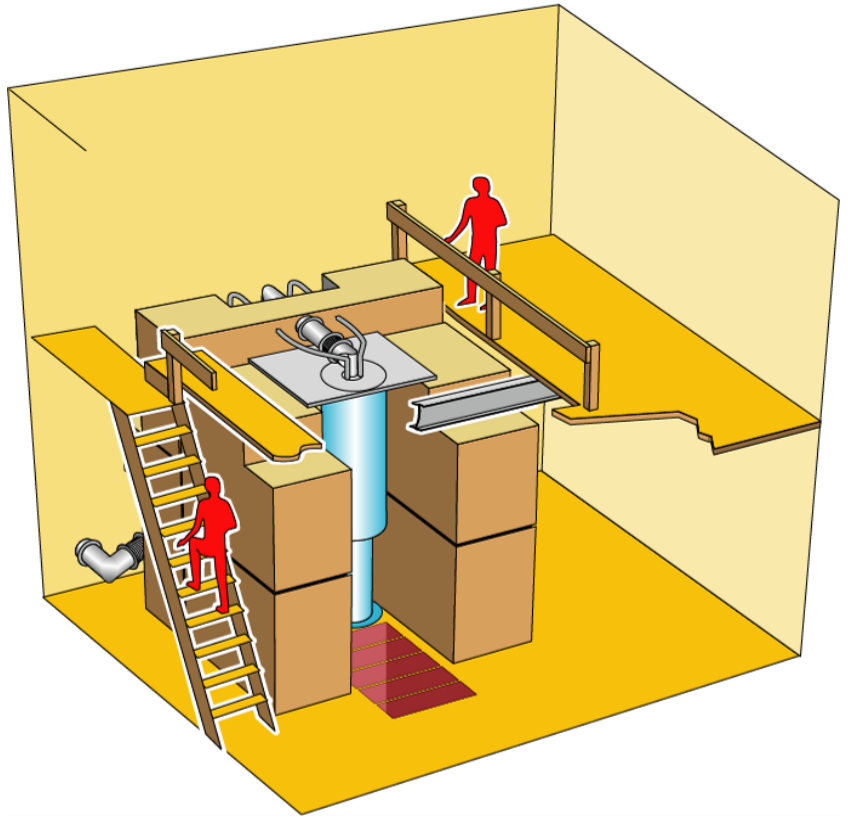
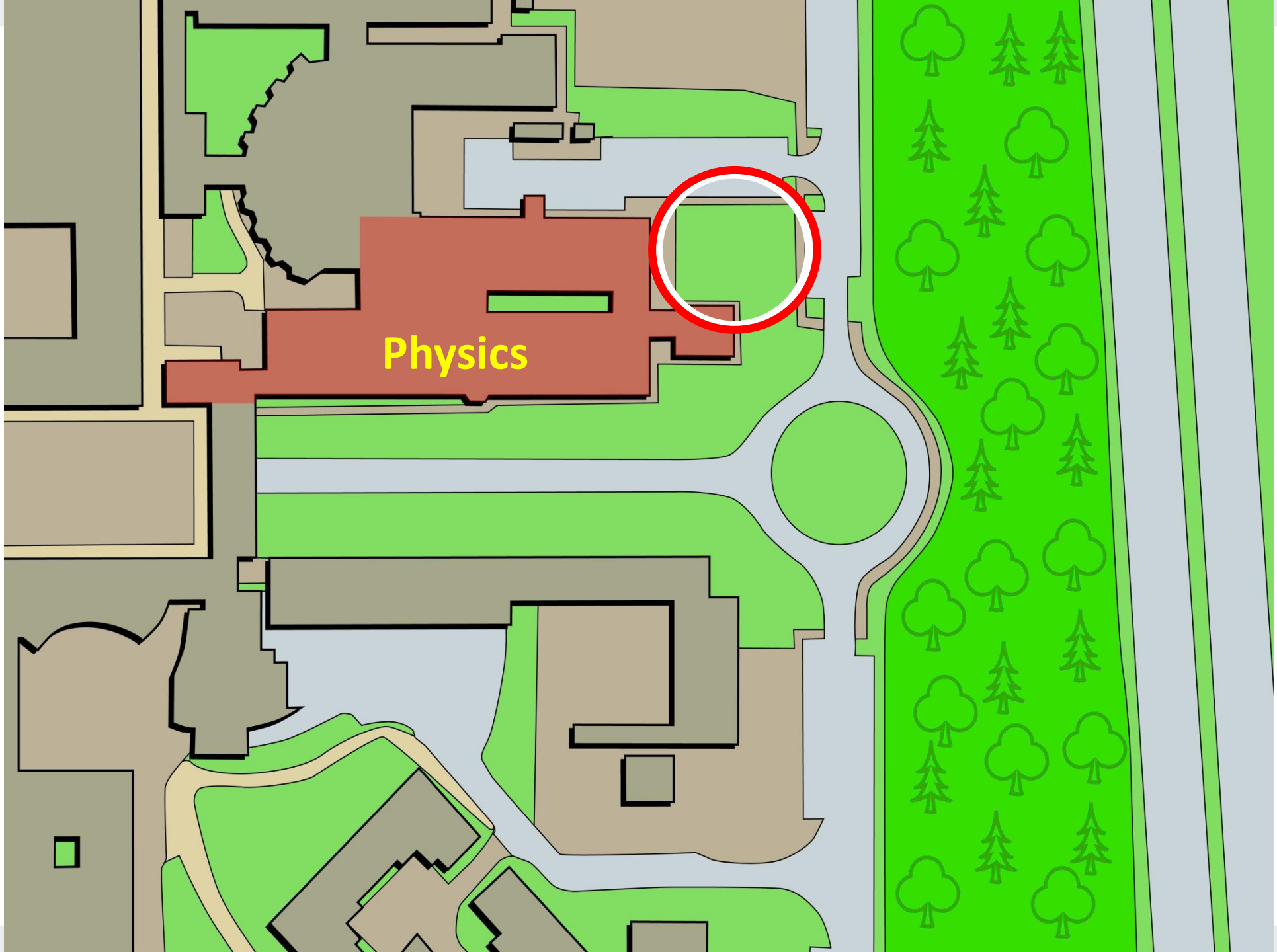


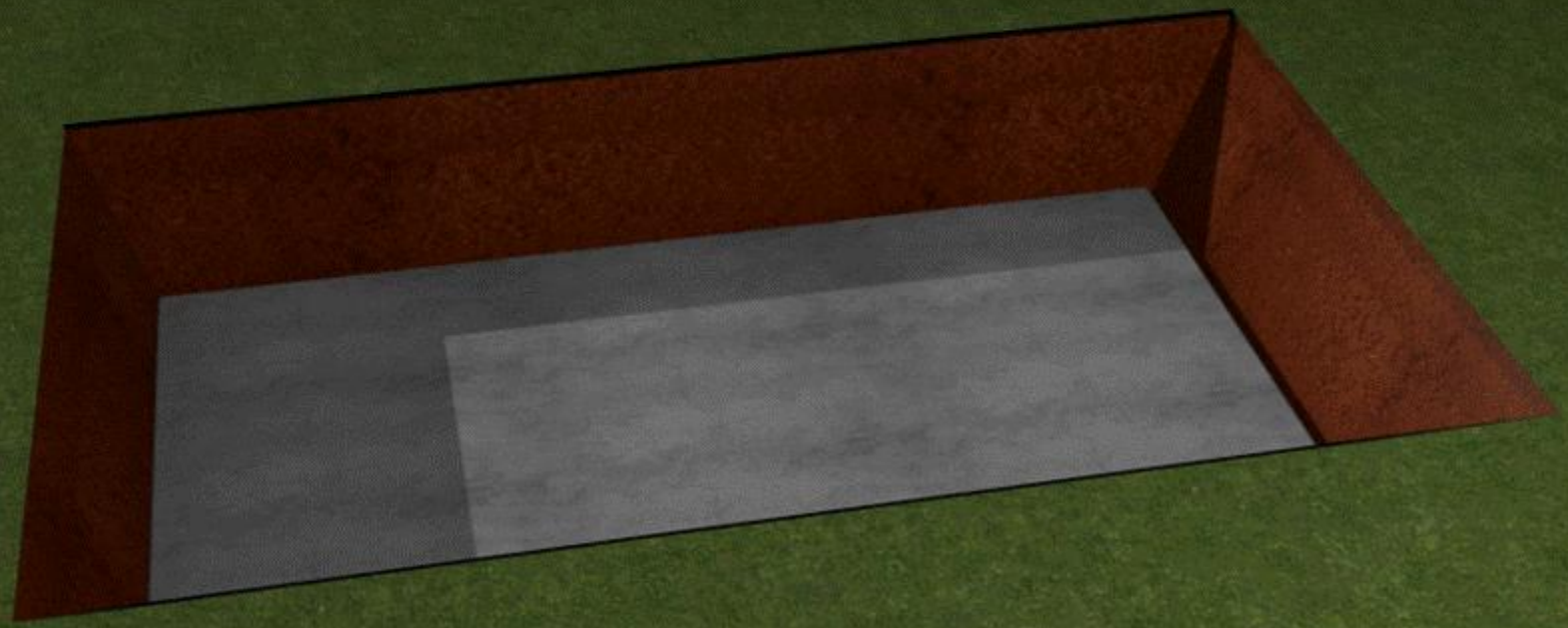


IsoLab build process

- The project was delivered through a design and build contract. The building was co-designed by academic staff and contractors.
- Approach: apply best practice and assess final performance.
- Total build cost around £2M. Value of the final facility likely £10M or more.

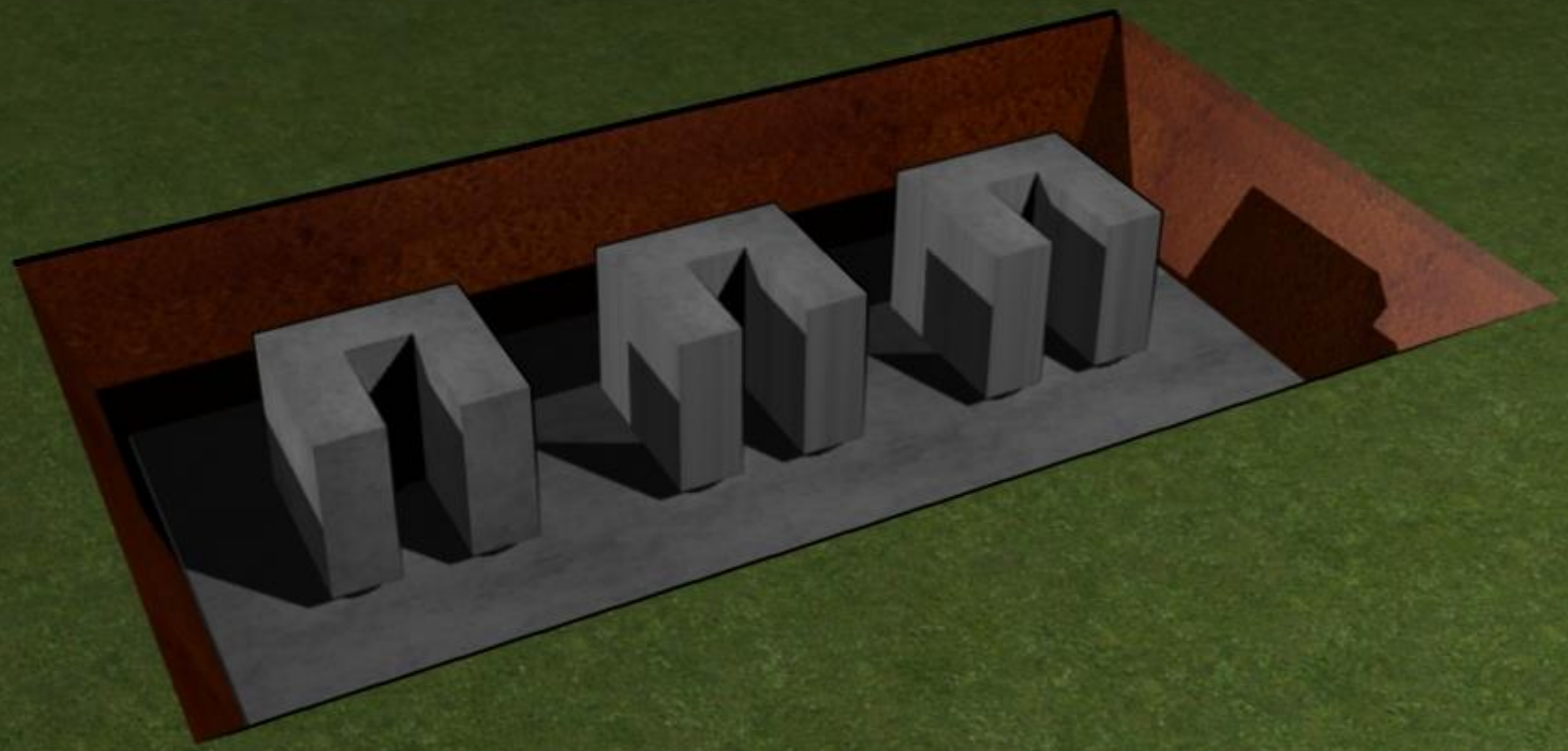

Physics

Fill with a 160-tonne concrete slab.



This is a good start – a large mass nestling on a damped bed of glacial clay

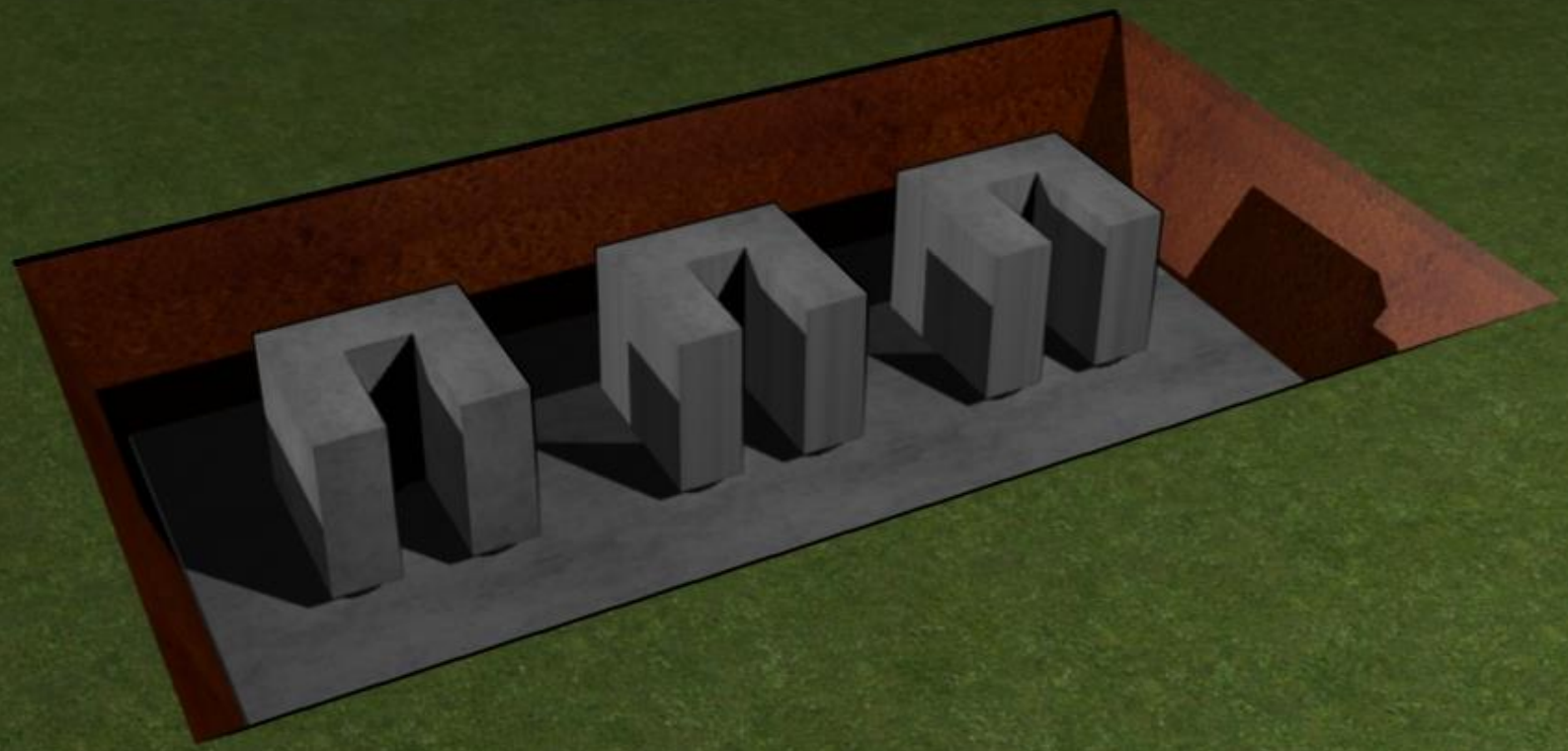
Blocks are reinforced with non-magnetic stainless steel.



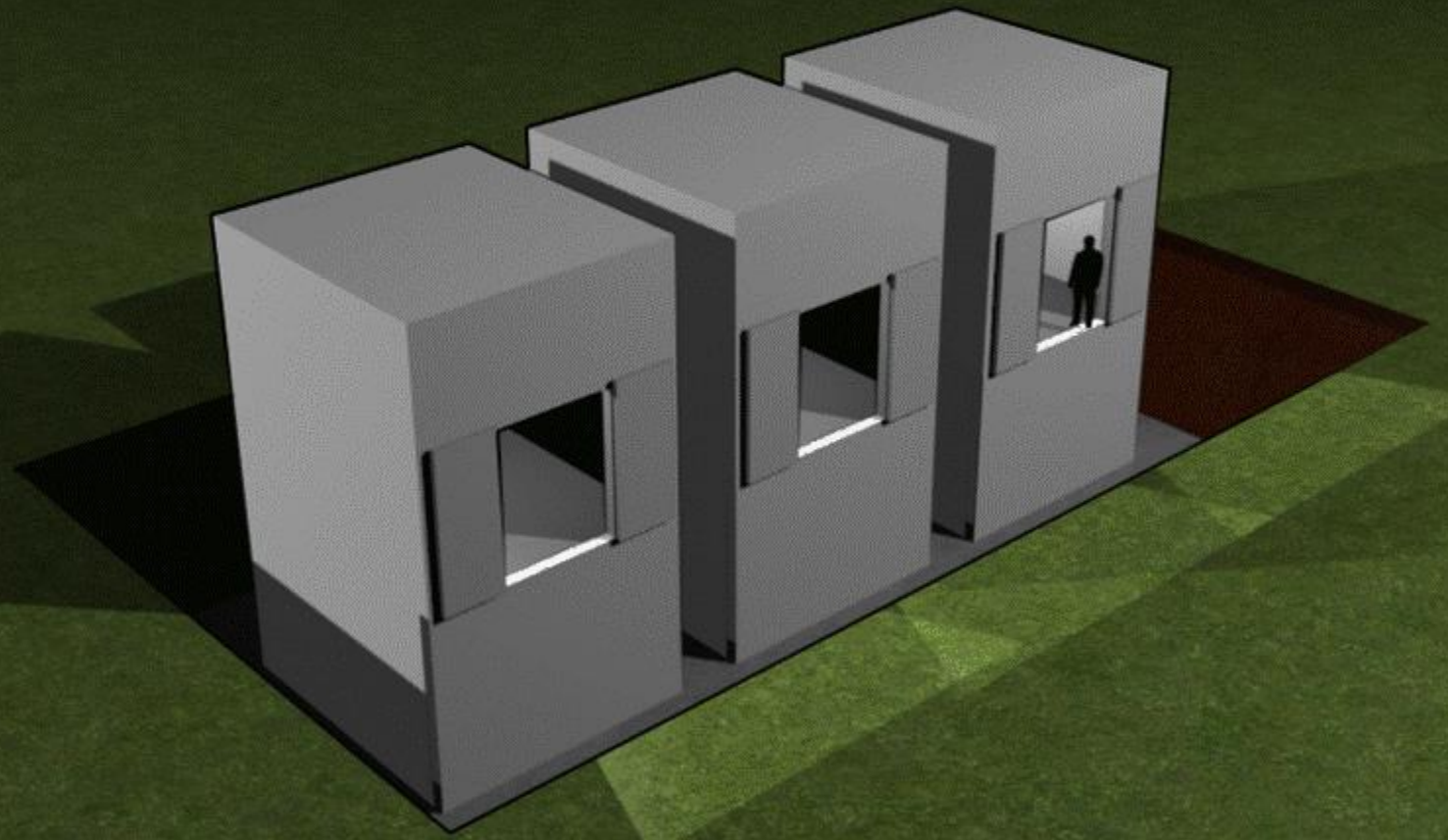
Blocks are reinforced with non-magnetic stainless steel.

Air-springs isolate the blocks from ground vibration.

To protect from airborne vibration, each block is surrounded with a concrete blockwork pod.



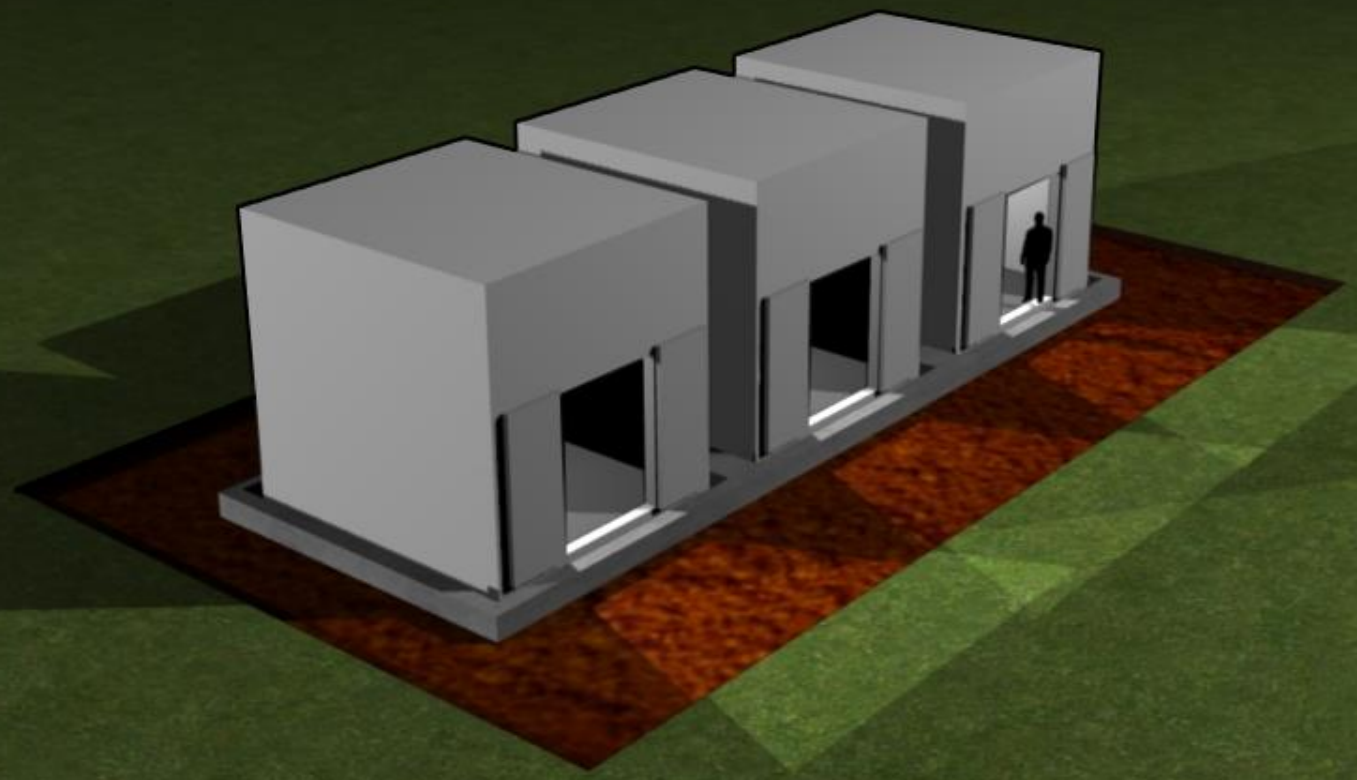
Pods are lined inside with metal shielding to exclude electro-magnetic disturbance.



Removable false floors are installed at ground level.

The scientific part is now essentially complete.

We just need an outer shell to keep out the rain. (But this must be a completely separate structure.)



Add a new set of foundations, separated from the inner structure.


Then finally add the external shell.


isolab


IsoLab
IsoLab ISO

Three isolation laboratories

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Funded by Lancaster University and donations from

- The Wolfson Foundation
- J.P. Moulton Charitable Foundation
- Garfield Weston Foundation

Initial equipment was supported by an EPSRC award.

Since opening in 2017, work in IsoLab has attracted more than £10M in additional external funding.

Industrial Collaboration

Two spin-out companies in IsoLab:

- Lancaster Material Analysis
- Quantum Base

Collaborations with Oxford Instruments Nanoscience funded by Innovate UK.

Projects with 13 other companies in IsoLab since 2017.

Capabilities

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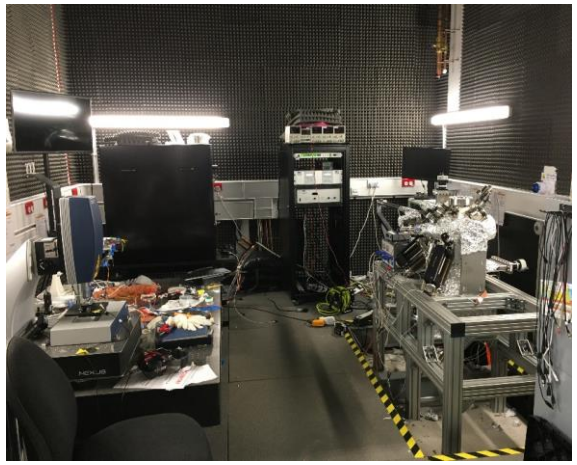
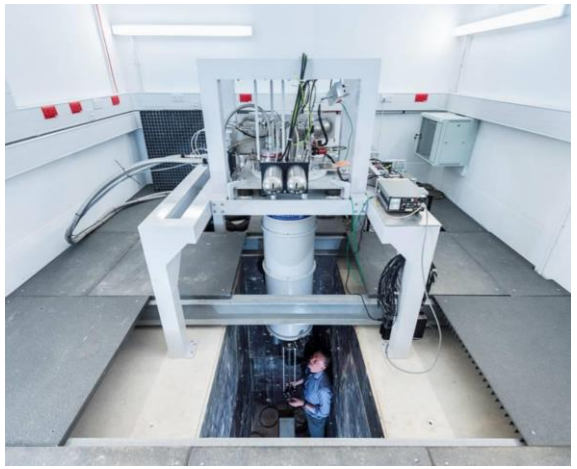
Pod 1
Atomic scale microscopy



Pod 2
Quantum security

Pod 3
Ultralow temperature physics



- IsoLab access is managed through open collaboration.
- All users contribute to improving the lab and best practice is shared.

Atomic scale microscopy Pod

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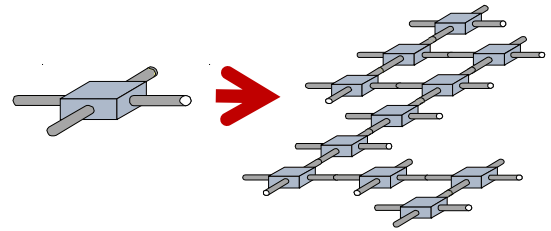
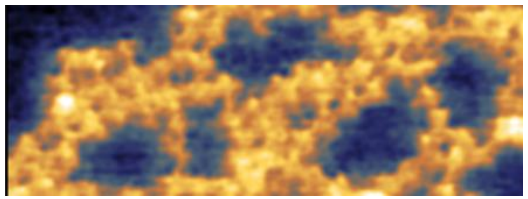
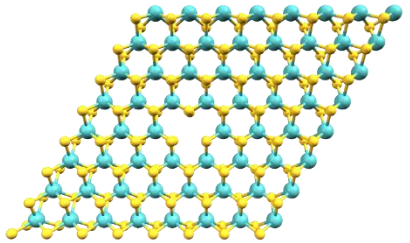
Equipped with sub-molecular resolution SPM.

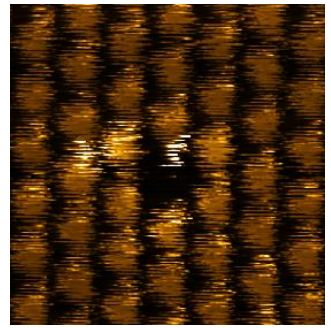




Current work on:

- Molecular electronics,
- Thermoelectric systems,
- Surface chemistry + single atom catalysts,
- UHV STM/AFM, ambient AFM, ambient STM.





Quantum Security Pod

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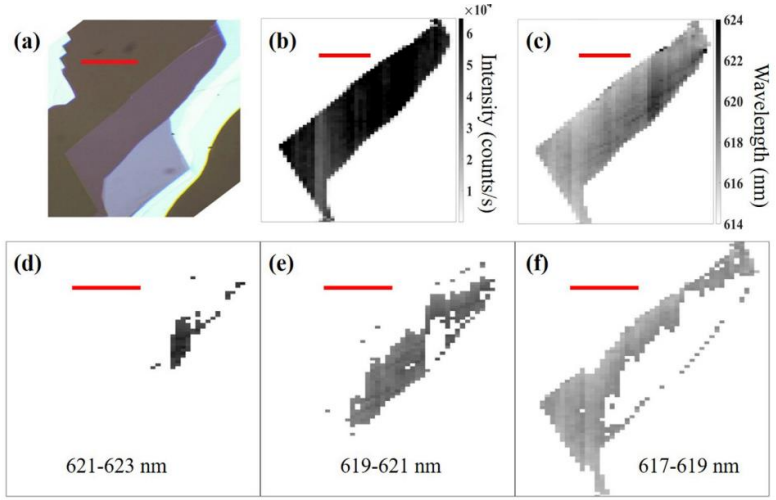
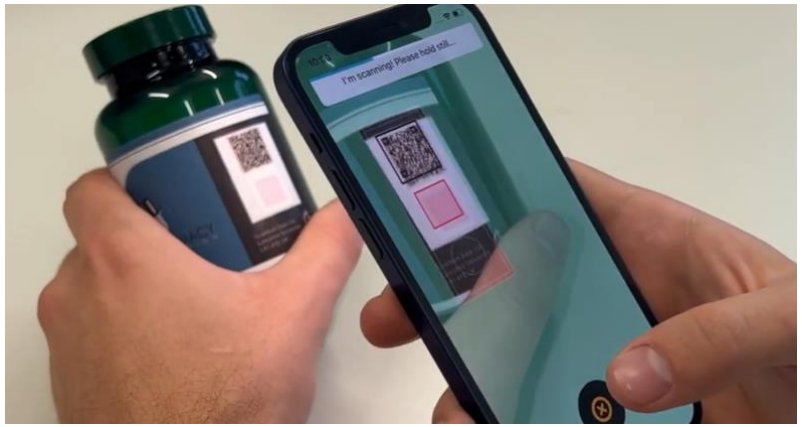
Specialised for quantum optics

Current work on:

- Unique quantum optical IDs,
- Physically unclonable functions,
- Micro Raman, Photoluminescence.





Quantum Base

Ultralow Temperature Physics

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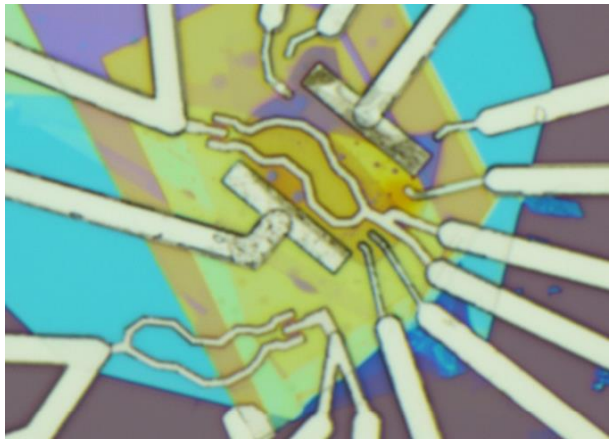
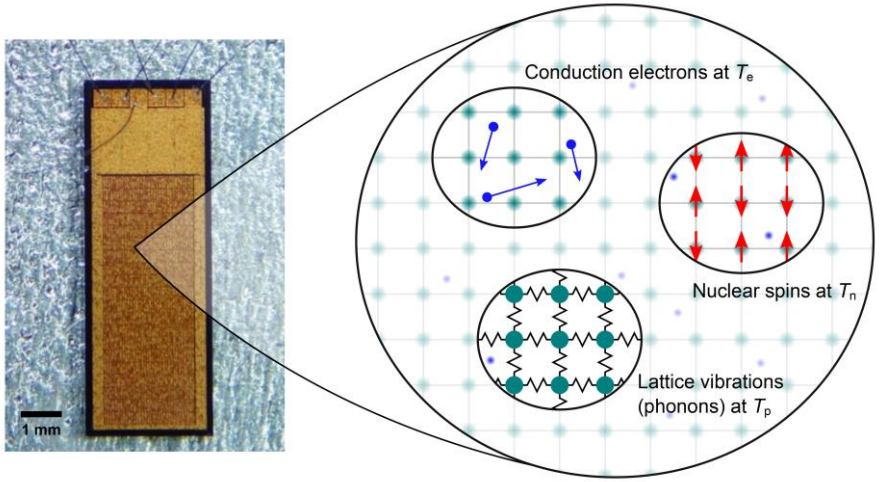


Oxford Instruments Triton dilution refrigerator.

Currently upgrading for multi-qubit measurement capability.

Current work on,

- hybrid superconducting devices,
- on-chip demagnetisation refrigeration,
- thermal management for cryogenic electronics.



Public engagement

IsoLab has proved to be a great focus for public engagement activities.

An exhibit called “The Art of Isolation” showcased IsoLab research at New Scientist Live in 2018 and The Royal Society Summer Science Exhibition in 2019 (next door!)

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Any questions?