

PPD Away Day

Dec 24

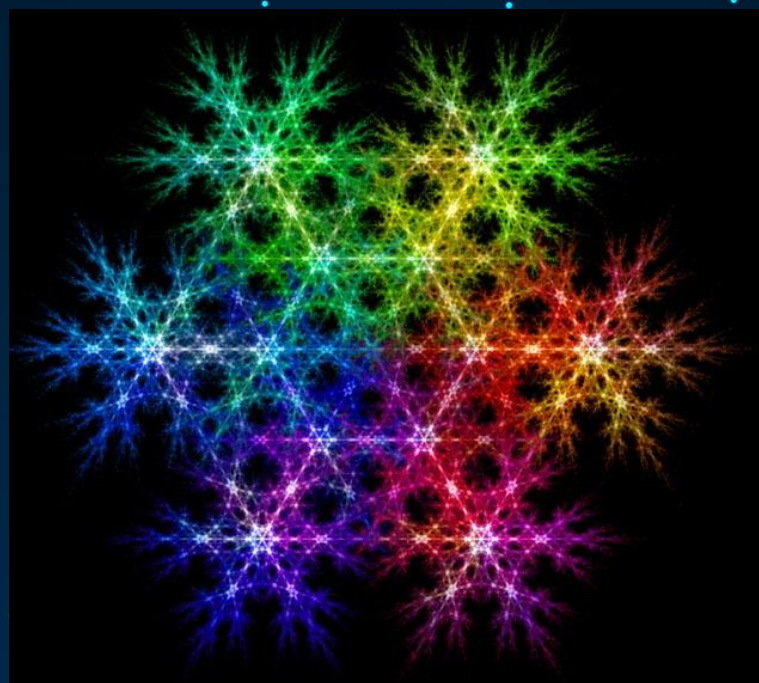
Quantum - AION

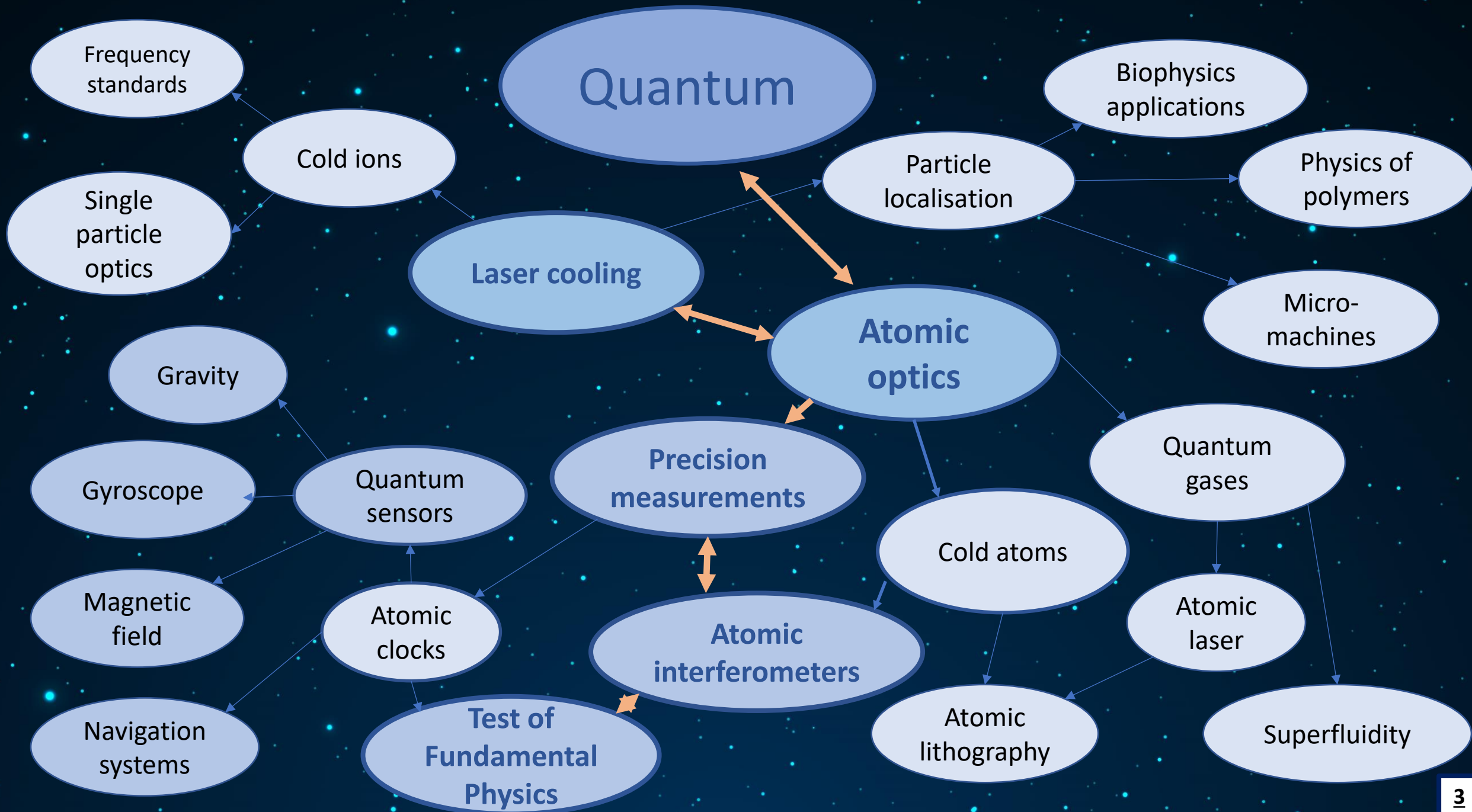
&

**Cold Radon Emanation
Facility at RAL**



QUANTUM SENSORS AND TECHNOLOGIES EVERYTHING EVERYWHERE ALL-AROUND





Quantum Technologies → Fundamental Physics

- QTFP proposal 2019
- Brings together STFC and EPSRC communities
- Multi-staged long-term project (AION-10, AION-100, AION 1km, ...)
- Partnering/participating with MAGIS
- Cross departmental RAL input

TD

space

PPD

AION:

A UK Atom Interferometer Observatory and Network *Standard Proposal*

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J. Zielinska⁶

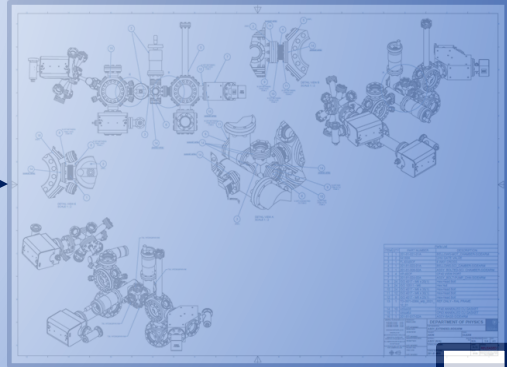
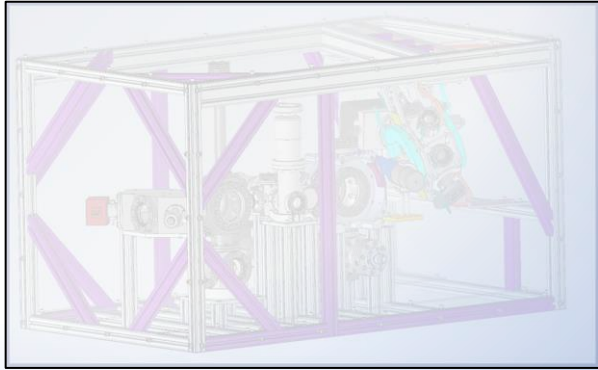
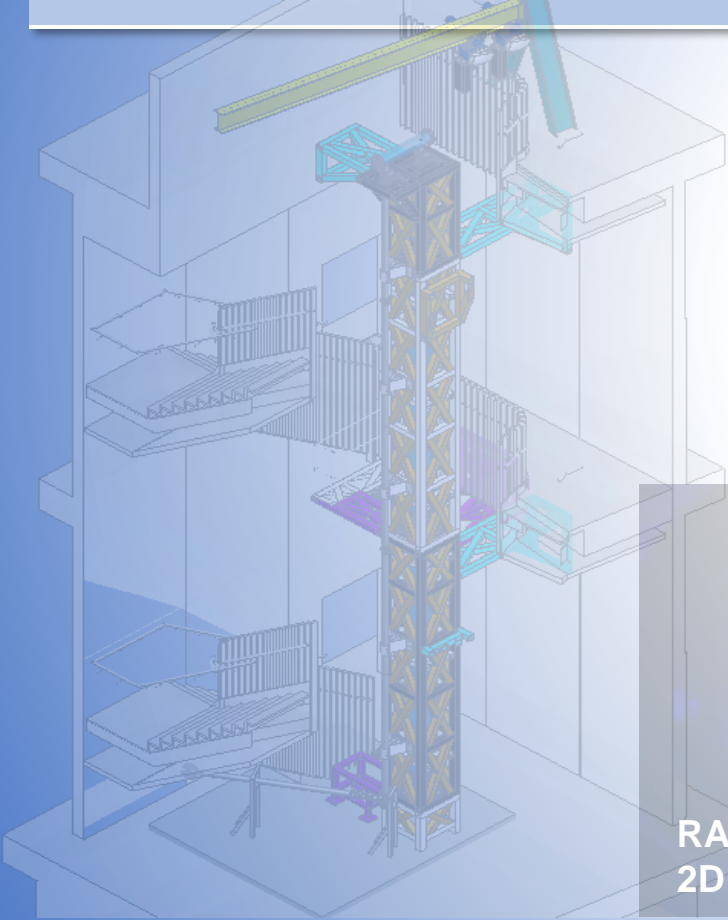
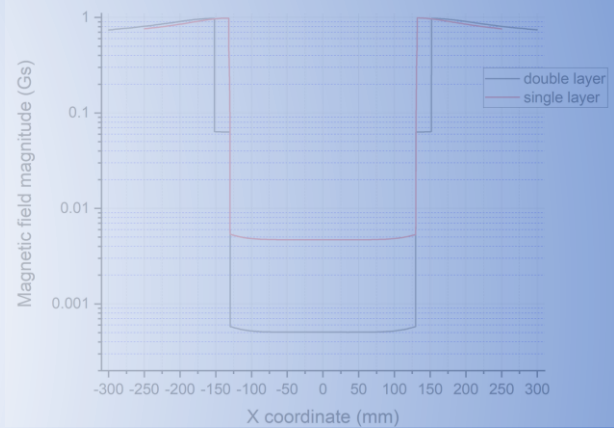
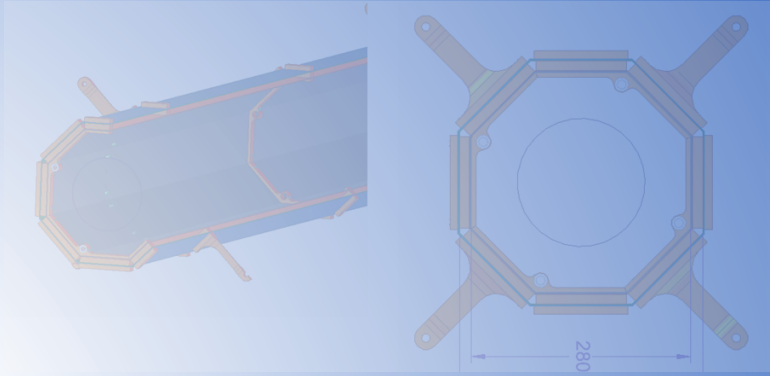
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of Cambridge



In partnership with UK National Quantum Technology Hub in Sensors and Timing, Birmingham, U
The MAGIS Collaboration, US and the Fermi National Accelerator Laboratory, US

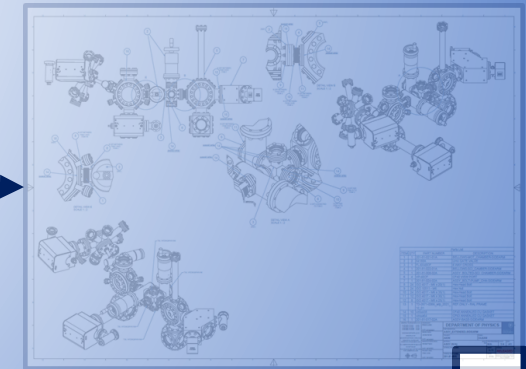
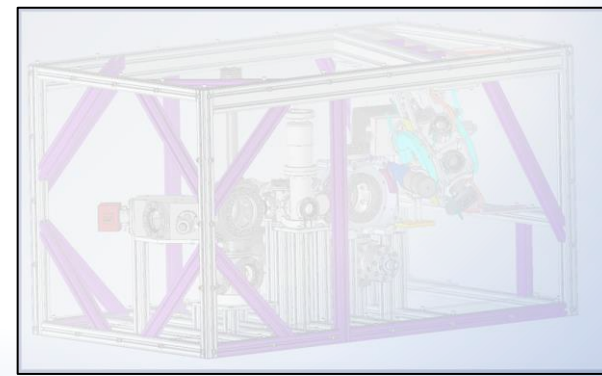
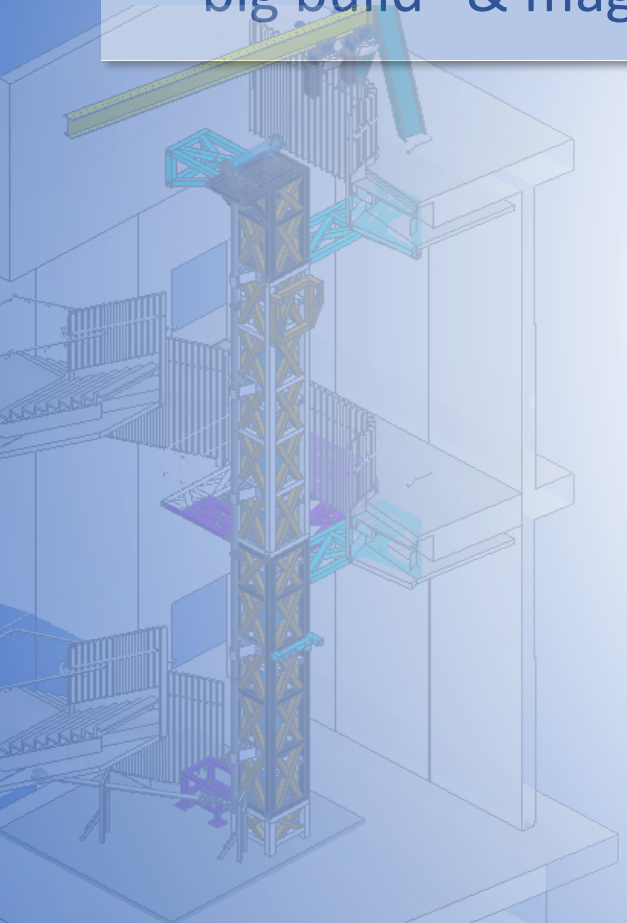
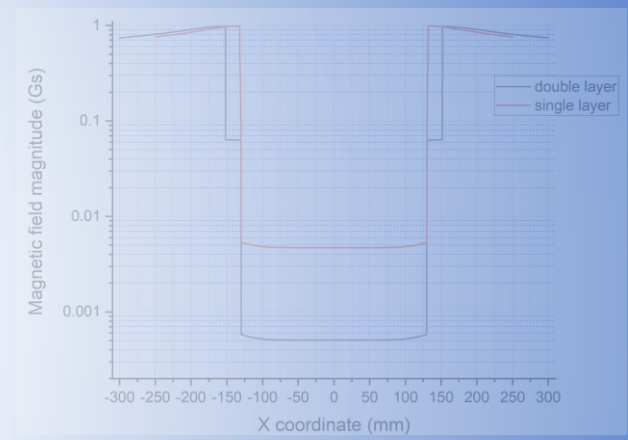
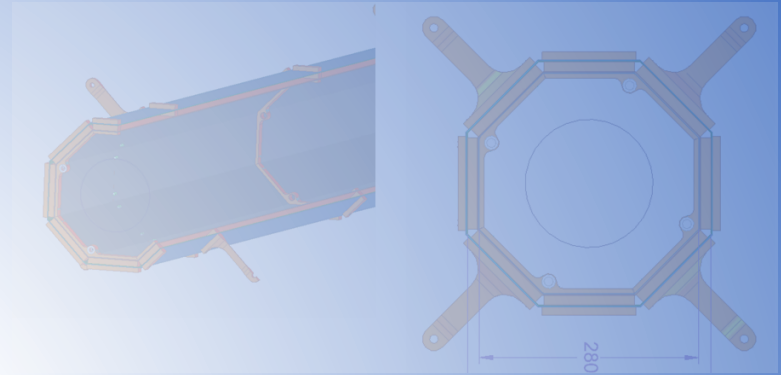
Three gifts of expertise

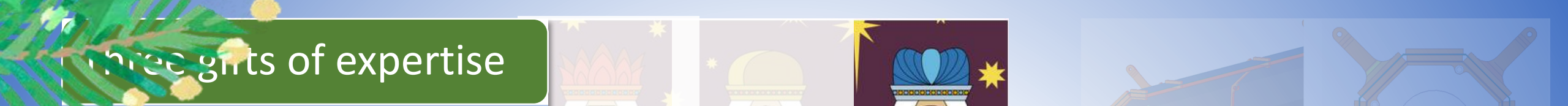
- ❖ Cold atom interferometry
- ❖ Design & engineering
- ❖ “big build” & magnetics



Three gifts of expertise

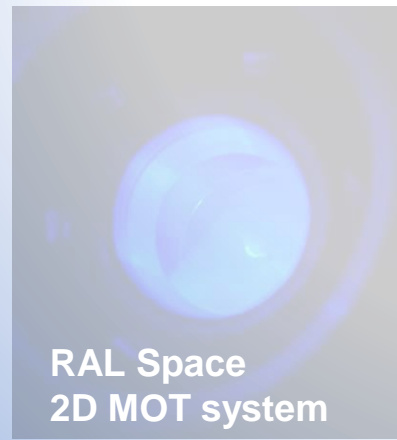
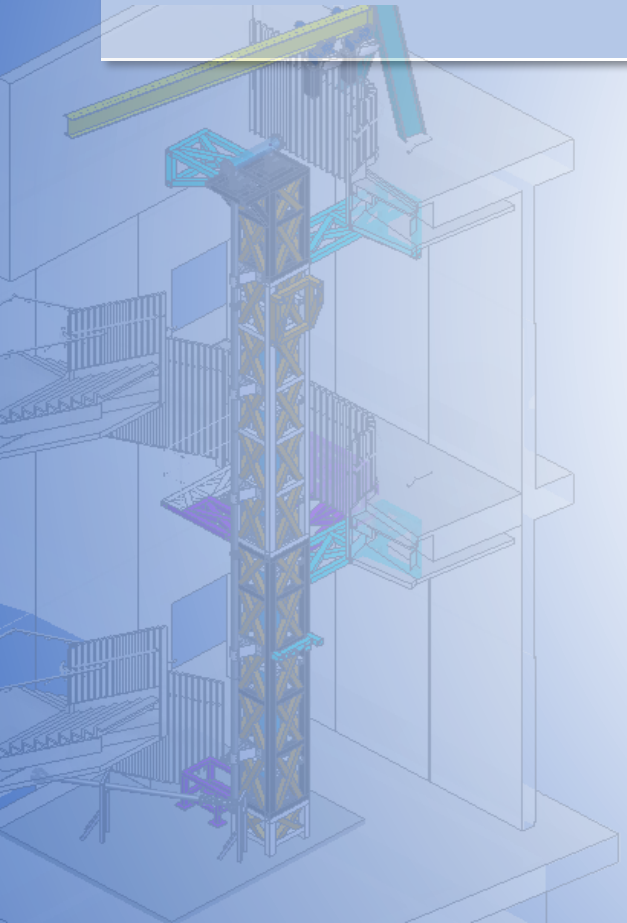
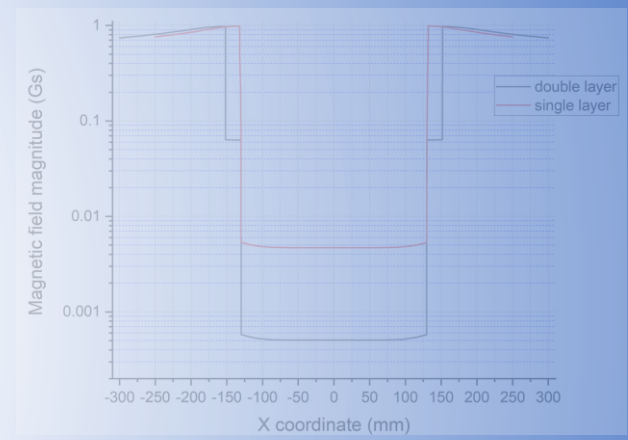
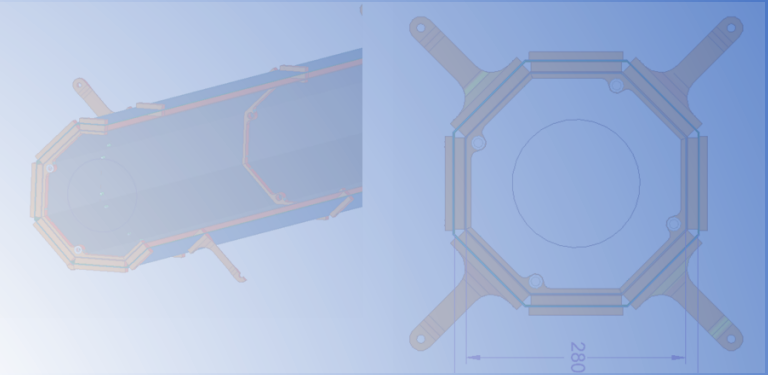
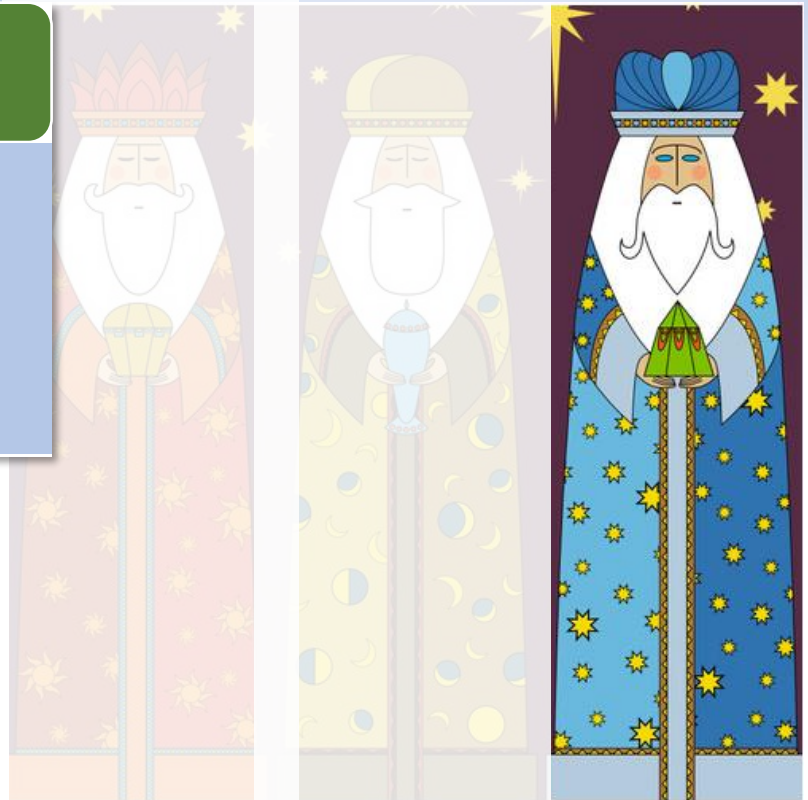
- Cold atom interferometry
- Design & engineering
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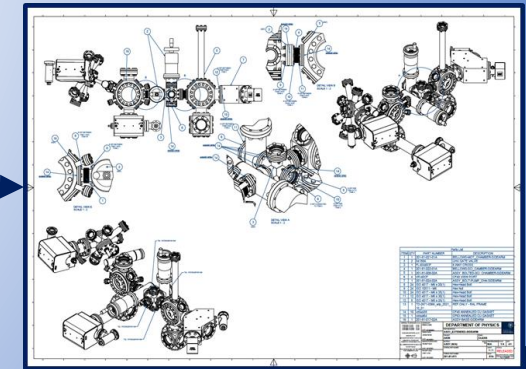
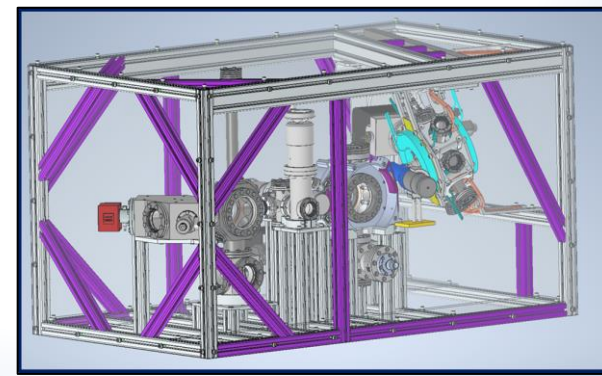


Three gifts of expertise

- Cold atom interferometry
- **Design & engineering**
- “big build” & magnetics

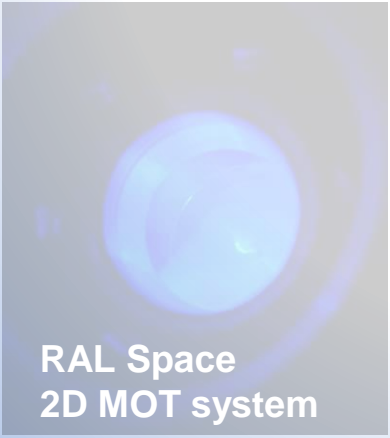
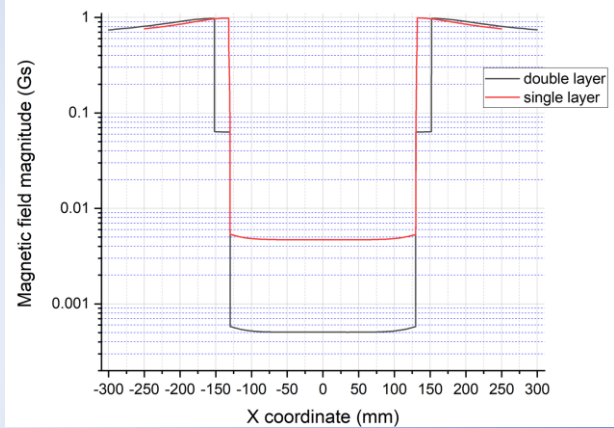
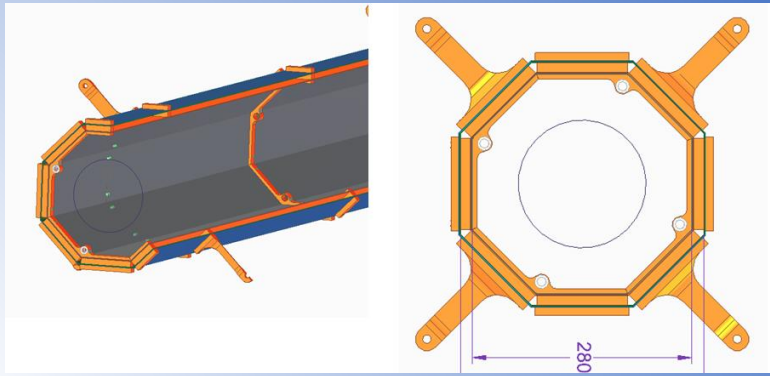
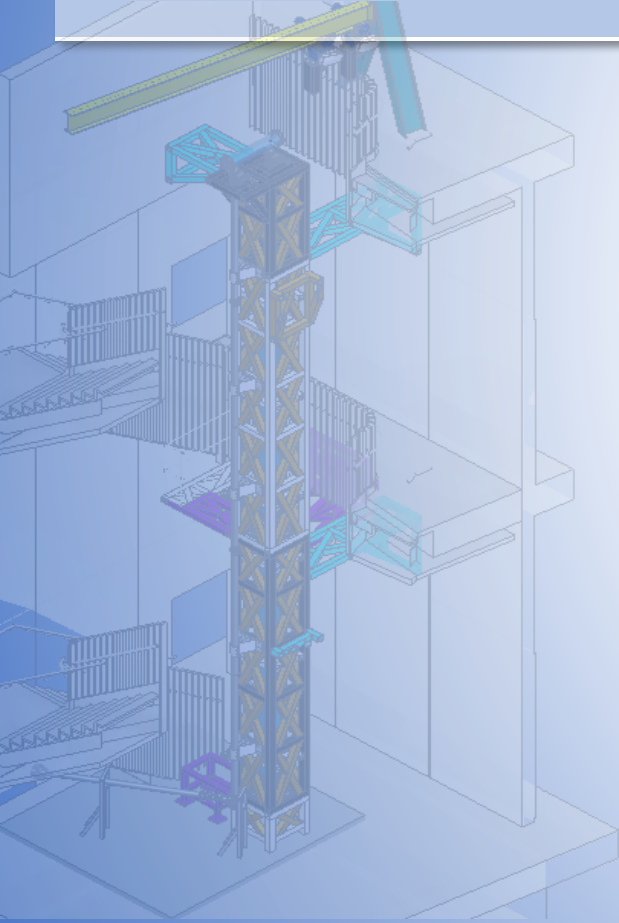


RAL Space
2D MOT system

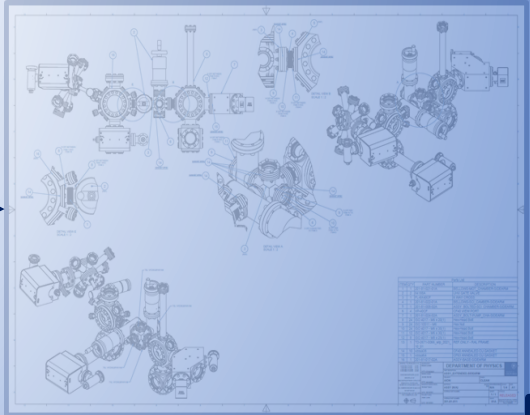
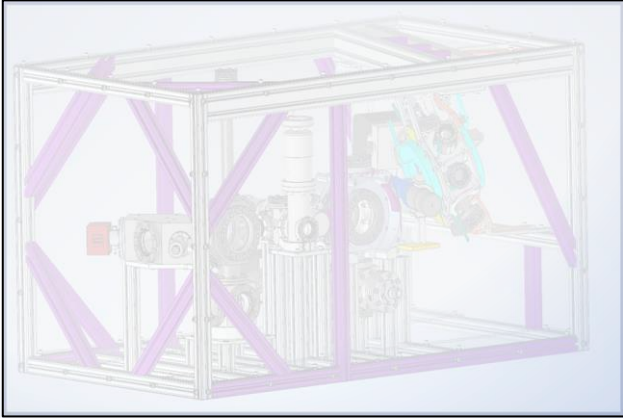


Three gifts of expertise

- Cold atom interferometry
- Design & engineering
- **“big build” & magnetics**

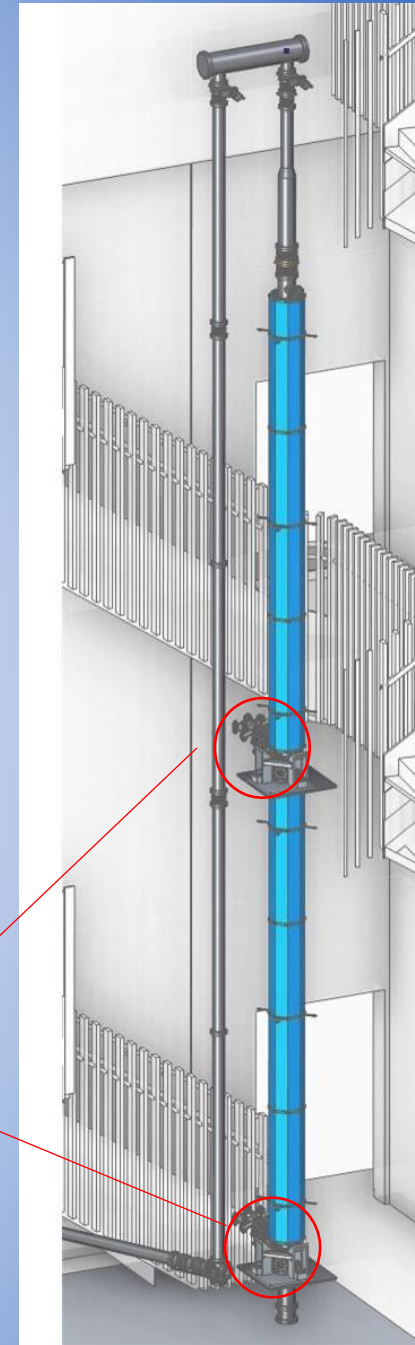
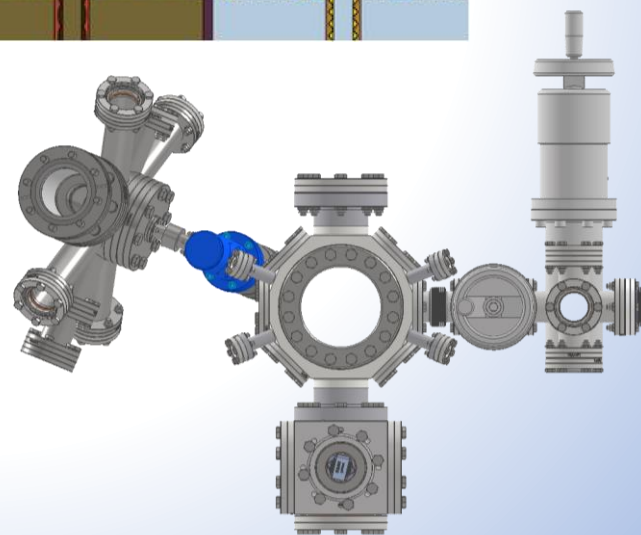
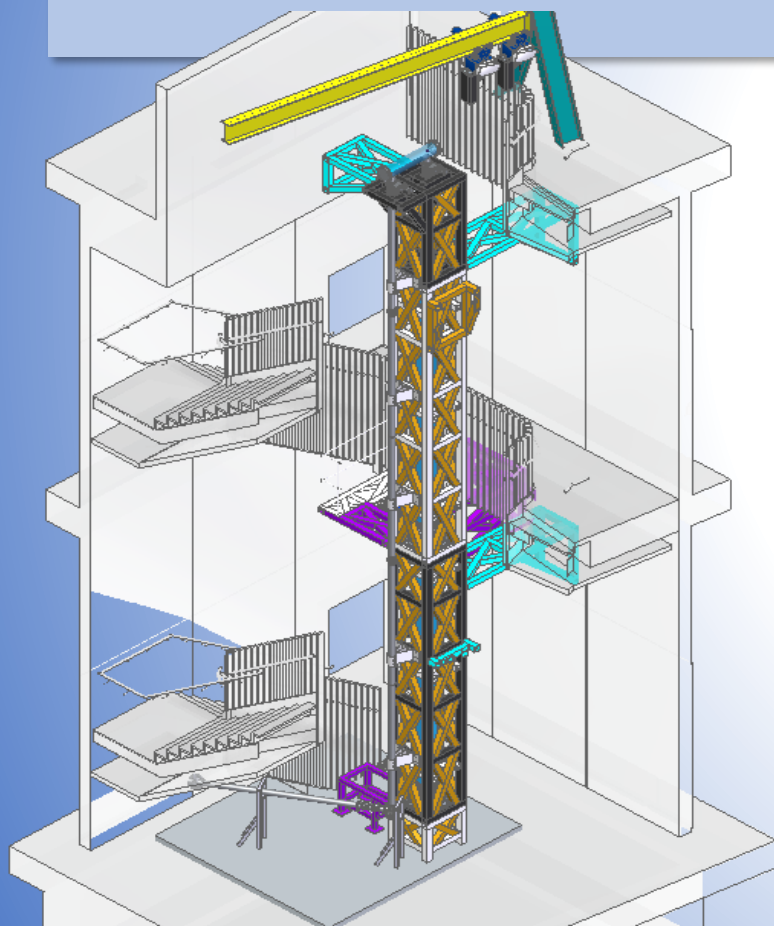


RAL Space
2D MOT system



Three gifts of expertise

- ❖ Cold atom interferometry
- ❖ Design & engineering
- ❖ "big build" & magnetics



Elves next jobs - resolutions

- ❖ Agreeing what goes in the gift bag
- ❖ Buy and manufacture
- ❖ Build
- ❖ TVLBAI

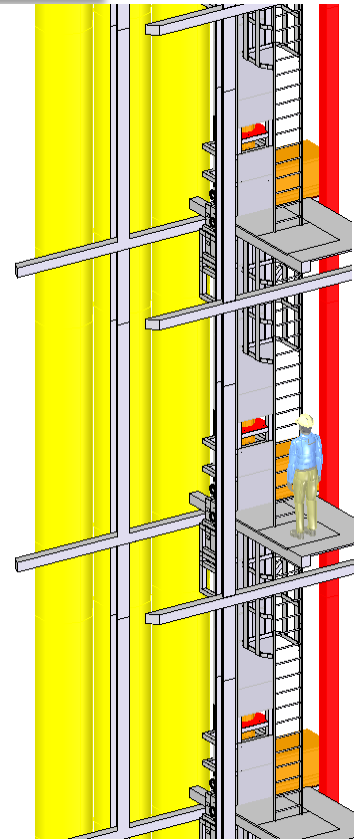


Wish list

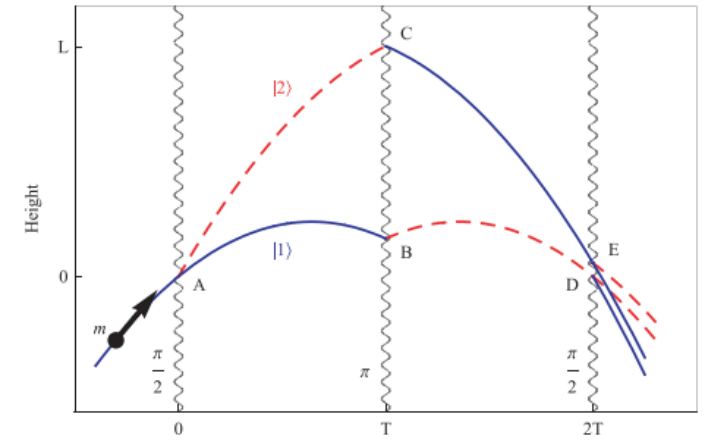
- ❖ Terrestrial Very Long Baseline Atom Interferometer
- ❖ Big magnetics survey facility
- ❖ Large, vertical, experimental facility



Terrestrial



Very Long Baseline

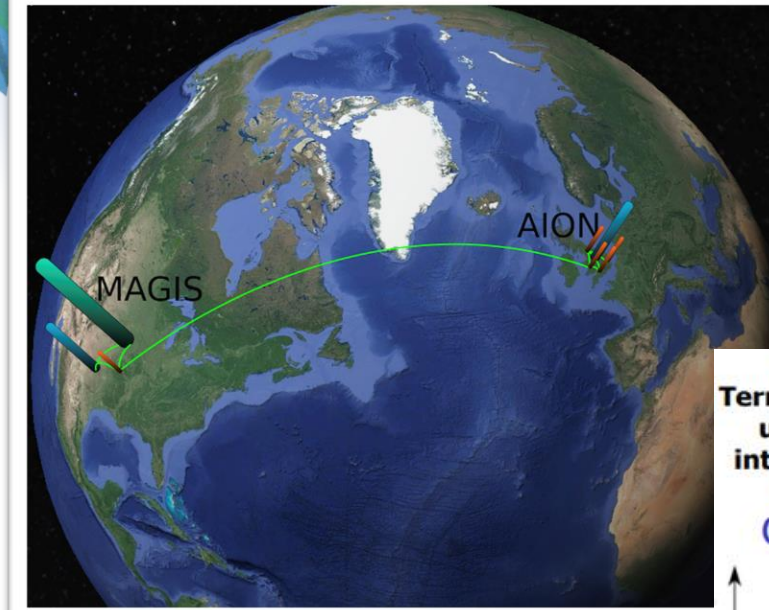
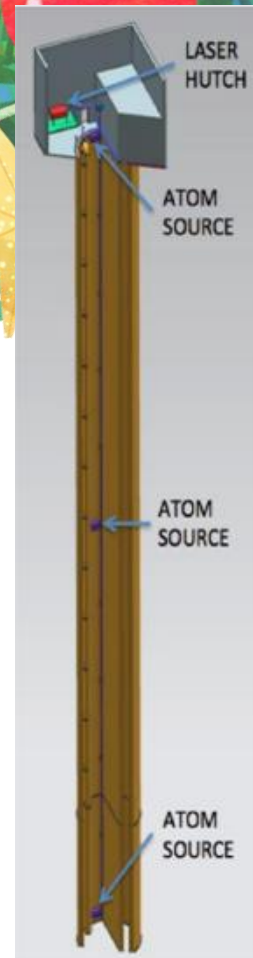


Atom Interferometry



Bringing the world together

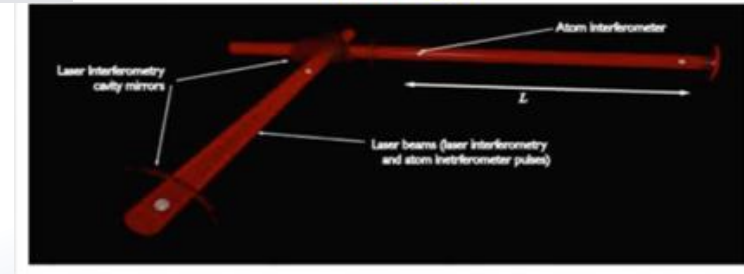
- ❖ In the UK
- ❖ On Earth
- ❖ And...reaching for the stars



VLBAI:
Terrestrial tower using atom interferometer
O(10m)
(Germany)



MIGA: Terrestrial detector using atom interferometer at O(100m)
(France)





Noises Off



Silent night.
Wholly dark.
All is calm,
Signal's clear.



What ho!



Who are we?

A small team in PPD RAL

+

colleagues in UK universities,
including UCL and KCL.

Where are we?

R5.2, underneath ISIS reception
(where the flags fly free)

Why are we?

To provide a noise-reduction
service for big new toys



A perfect training day

Radioactivity in Big Tanks...

tis naughty, not nice – it's
BAD, BAD, BAD



Queen Ar

King Xe

Mustn't nobble the nobles with common radon...



...even at low levels
that don't affect our elf.



If a stray radon atom decays inside a big tank of noble liquid, it “looks” like dark matter
(if that makes sense)

Seeing dark matter is about as likely as spotting Santa’s sleigh
- once per year if you’ve been very, very good



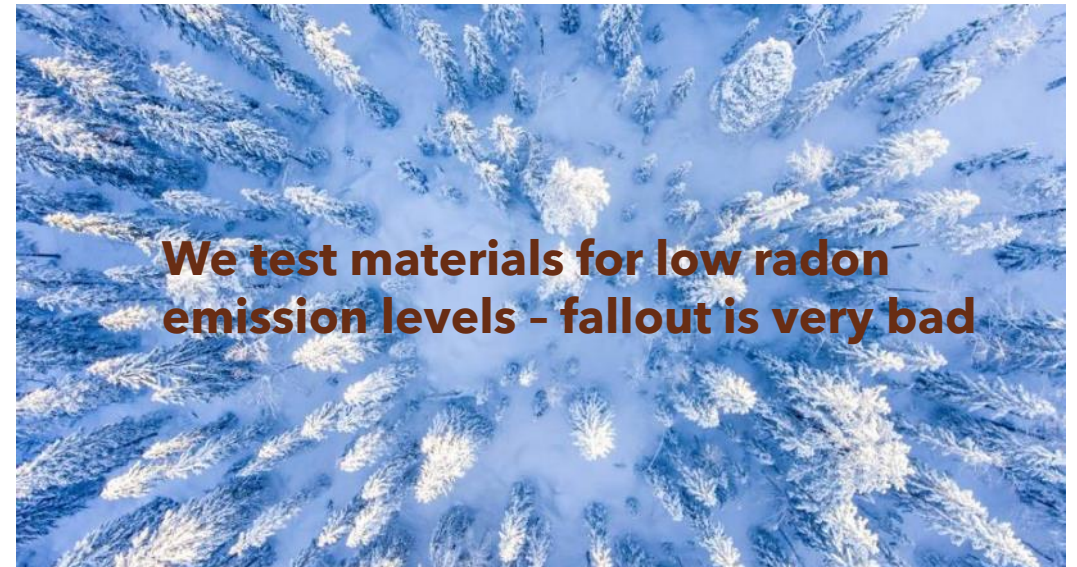
We can measure radon emanation rates from material samples as low as tens of microBecquerel (a few counts per day).

Our measurements have shown that radon emanation rates decrease when the temperature of the material is lowered.

Only quiet samples will then be included in the big new toys.



No more low-hanging fruit



We test materials for low radon emission levels - fallout is very bad



Santa's Experimental Tracker (DAQ)

Helps us count how many parcels have been delivered, where Santa is, etc.



CREFmas Wish



Expand our realm of ice and magic

A second cleanroom we have in store

We need the elves to build it quick

After Estates have prepared the floor

