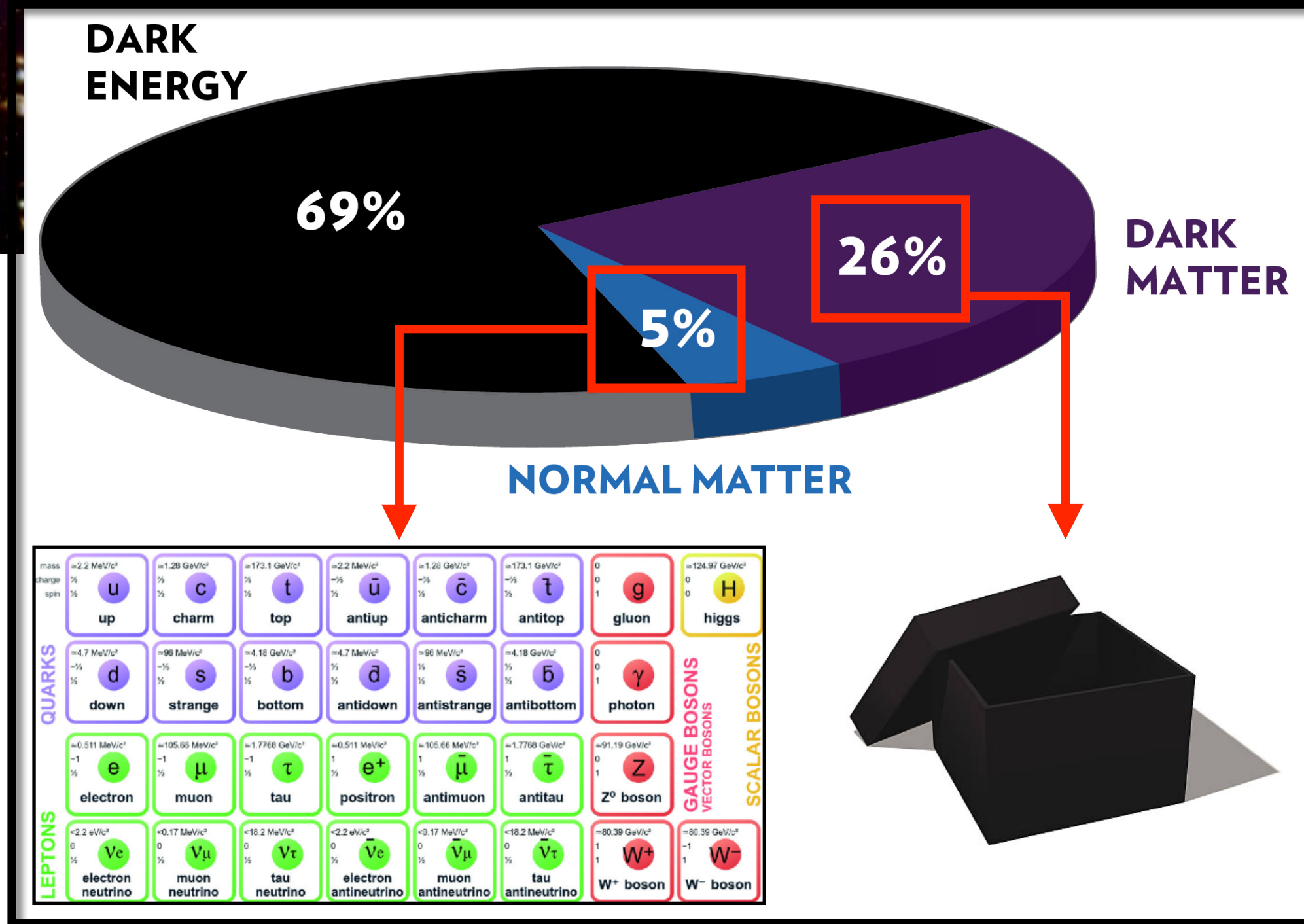
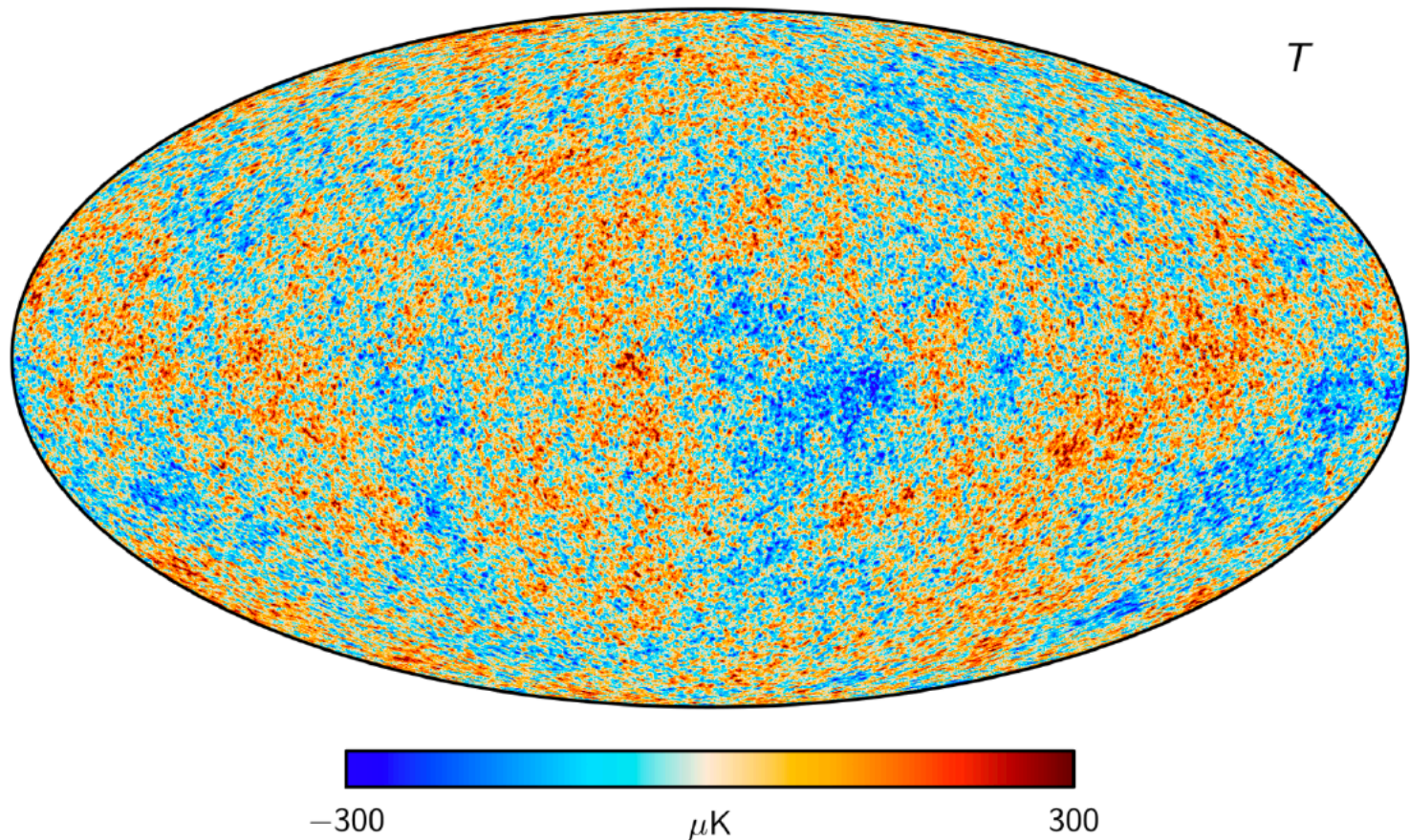
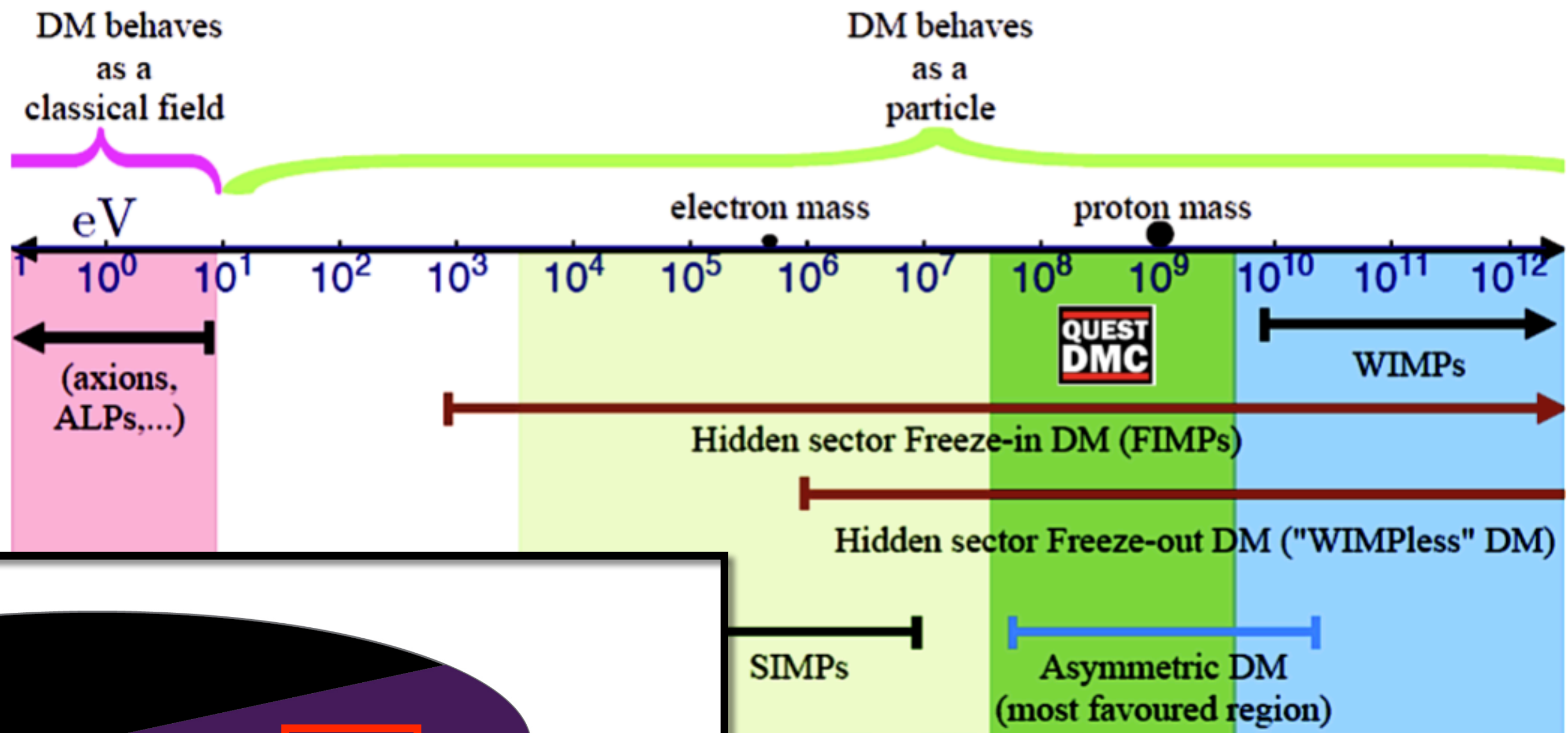


PPD Away Day: DarkSide-20k & QUEST-DMC

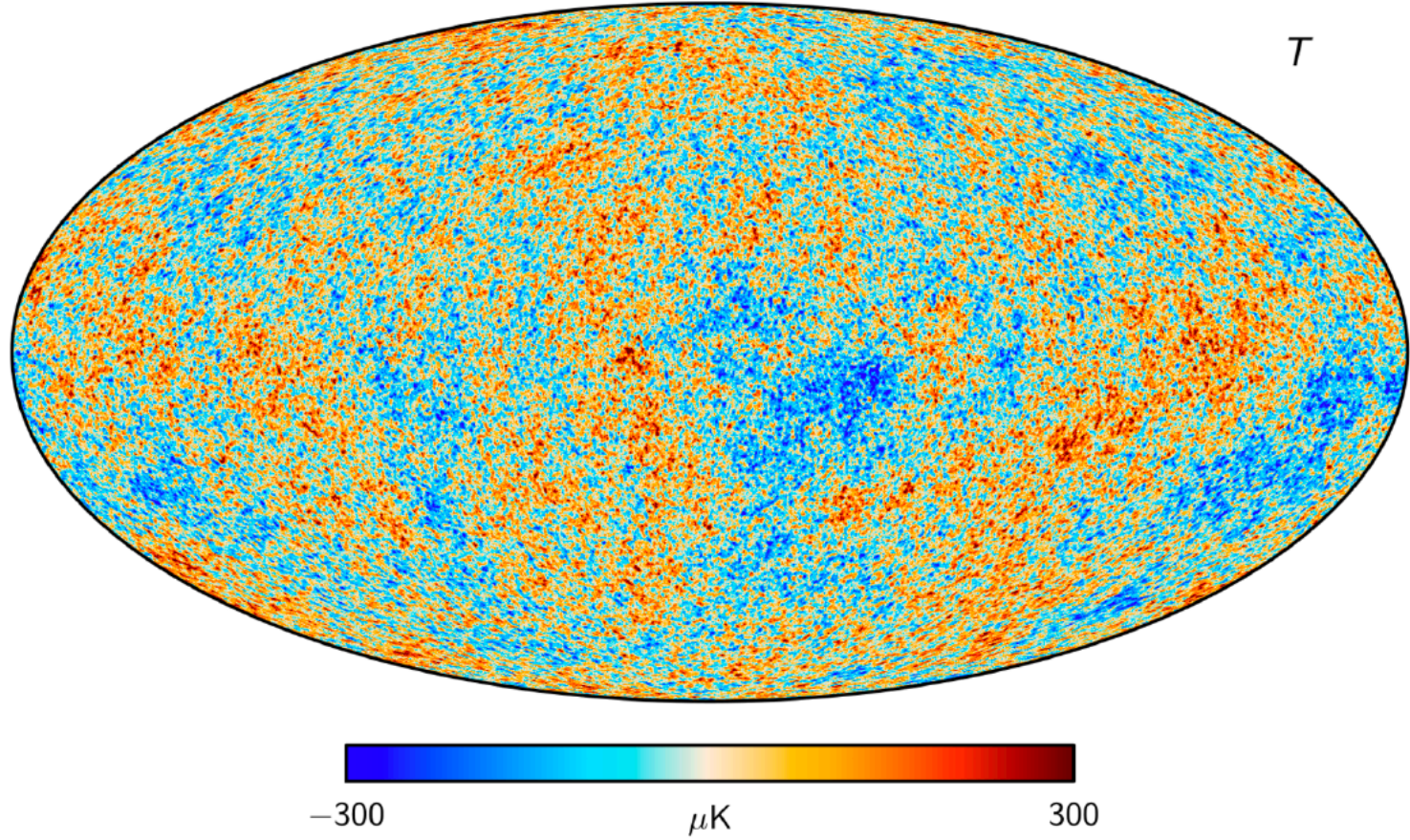
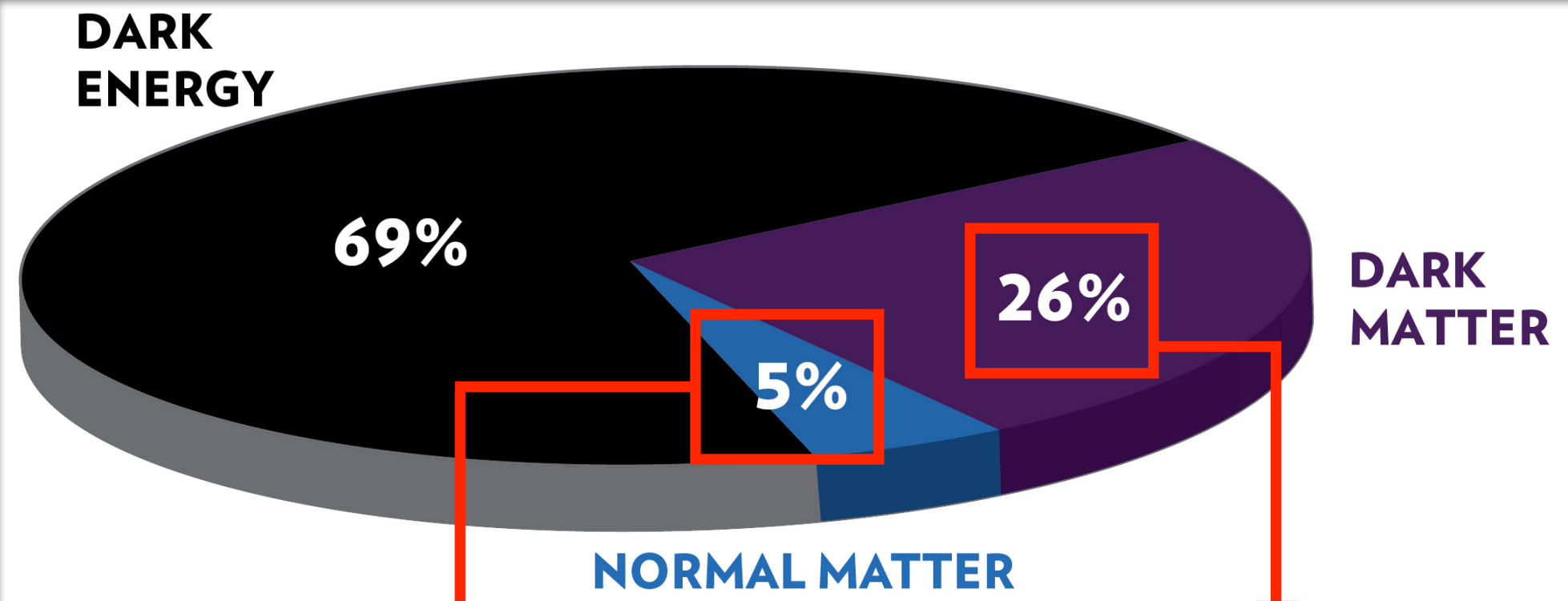
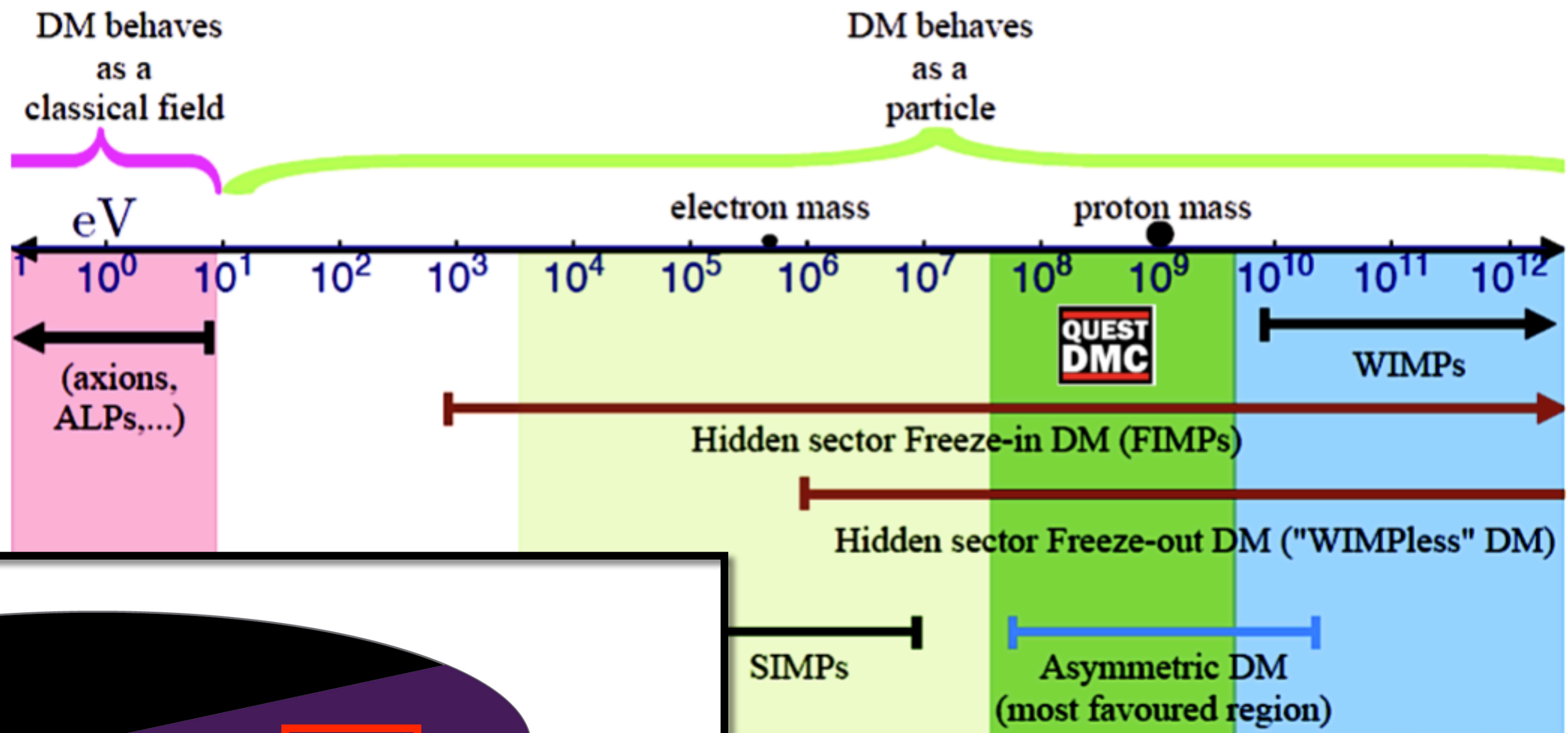
Ashlea Kemp & Jocelyn Monroe
2nd December 2024



Dear Santa: Let's Talk about Dark Matter



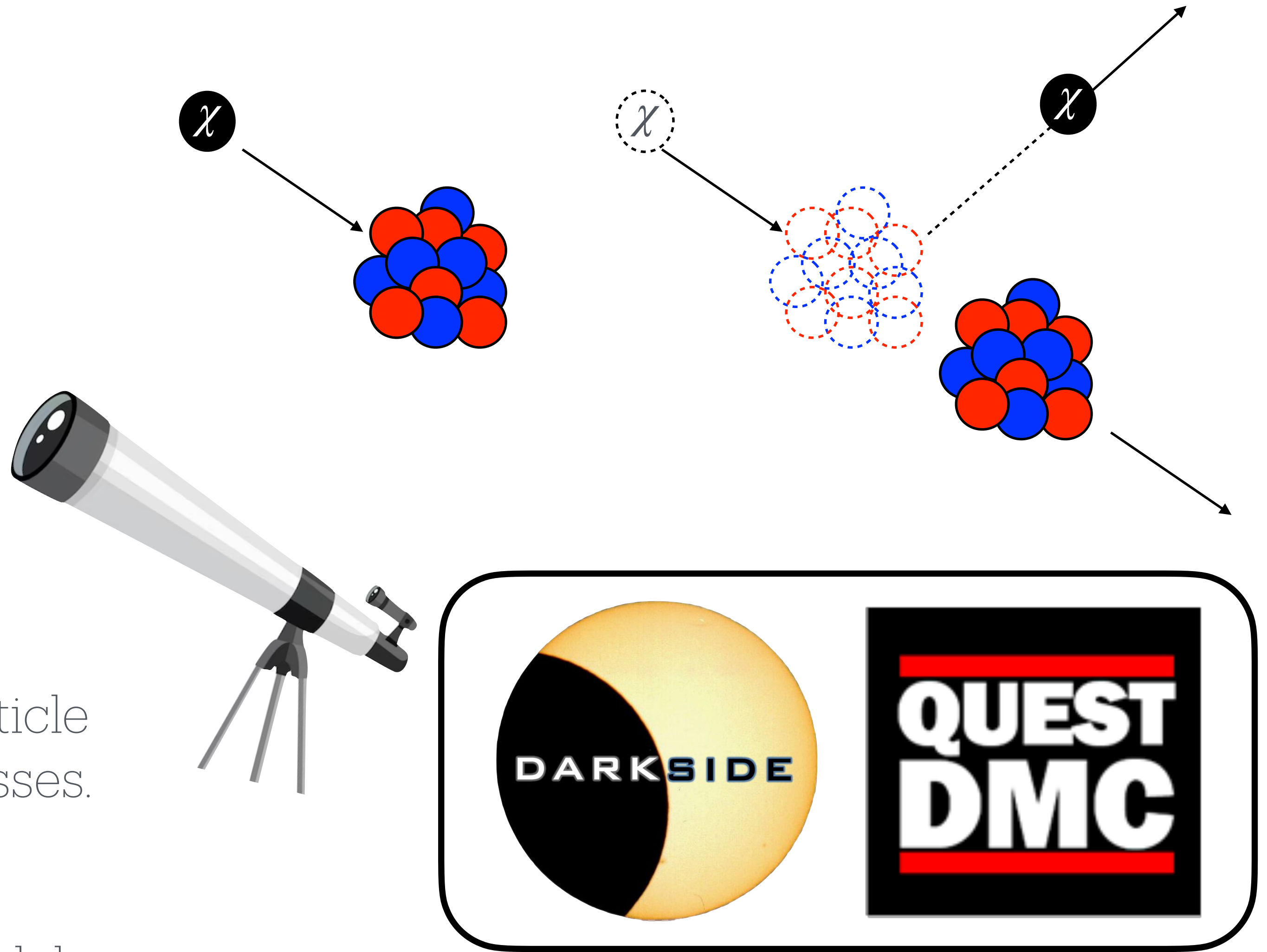
Dear Santa: Let's Talk about Dark Matter



<p>mass: 2.2 MeV/c², charge: 2/3, spin: 1/2</p> <p>u up</p>	<p>mass: 1.28 GeV/c², charge: 2/3, spin: 1/2</p> <p>c charm</p>	<p>mass: 173.1 GeV/c², charge: 2/3, spin: 1/2</p> <p>t top</p>	<p>mass: 2.2 MeV/c², charge: -2/3, spin: 1/2</p> <p>ū antiup</p>	<p>mass: 1.28 GeV/c², charge: -2/3, spin: 1/2</p> <p>c̄ anticharm</p>	<p>mass: 173.1 GeV/c², charge: -2/3, spin: 1/2</p> <p>t̄ antitop</p>	<p>mass: 0, charge: 0, spin: 1</p> <p>g gluon</p>	<p>mass: 124.97 GeV/c², charge: 0, spin: 0</p> <p>H higgs</p>
<p>mass: 4.7 MeV/c², charge: -1/3, spin: 1/2</p> <p>d down</p>	<p>mass: 96 MeV/c², charge: -1/3, spin: 1/2</p> <p>s strange</p>	<p>mass: 4.18 GeV/c², charge: -1/3, spin: 1/2</p> <p>b bottom</p>	<p>mass: 4.7 MeV/c², charge: 1/3, spin: 1/2</p> <p>d̄ antidown</p>	<p>mass: 96 MeV/c², charge: 1/3, spin: 1/2</p> <p>s̄ antistrange</p>	<p>mass: 4.18 GeV/c², charge: 1/3, spin: 1/2</p> <p>ḃ antibottom</p>	<p>mass: 0, charge: 0, spin: 1</p> <p>γ photon</p>	<p>mass: 0, charge: 0, spin: 1</p> <p>Z Z⁰ boson</p>
<p>mass: 0.511 MeV/c², charge: -1, spin: 1/2</p> <p>e electron</p>	<p>mass: 105.66 MeV/c², charge: -1, spin: 1/2</p> <p>μ muon</p>	<p>mass: 1.778 GeV/c², charge: -1, spin: 1/2</p> <p>τ tau</p>	<p>mass: 0.511 MeV/c², charge: 1, spin: 1/2</p> <p>e⁺ positron</p>	<p>mass: 105.66 MeV/c², charge: 1, spin: 1/2</p> <p>μ̄ antimuon</p>	<p>mass: 1.778 GeV/c², charge: 1, spin: 1/2</p> <p>τ̄ antitau</p>	<p>mass: 91.19 GeV/c², charge: 0, spin: 1</p> <p>Z Z⁰ boson</p>	<p>mass: 80.39 GeV/c², charge: 1, spin: 1</p> <p>W⁺ W⁺ boson</p>
<p>mass: 2.2 eV/c², charge: 0, spin: 1/2</p> <p>ν_e electron neutrino</p>	<p>mass: 0.17 MeV/c², charge: 0, spin: 1/2</p> <p>ν_μ muon neutrino</p>	<p>mass: 1.82 MeV/c², charge: 0, spin: 1/2</p> <p>ν_τ tau neutrino</p>	<p>mass: 2.2 eV/c², charge: 0, spin: 1/2</p> <p>ν̄_e electron antineutrino</p>	<p>mass: 0.17 MeV/c², charge: 0, spin: 1/2</p> <p>ν̄_μ muon antineutrino</p>	<p>mass: 1.82 MeV/c², charge: 0, spin: 1/2</p> <p>ν̄_τ tau antineutrino</p>	<p>mass: 80.39 GeV/c², charge: -1, spin: 1</p> <p>W⁻ W⁻ boson</p>	<p>mass: 80.39 GeV/c², charge: 0, spin: 0</p> <p>W⁺ W⁺ boson</p>



Dear Santa: Let's Talk about Dark Matter



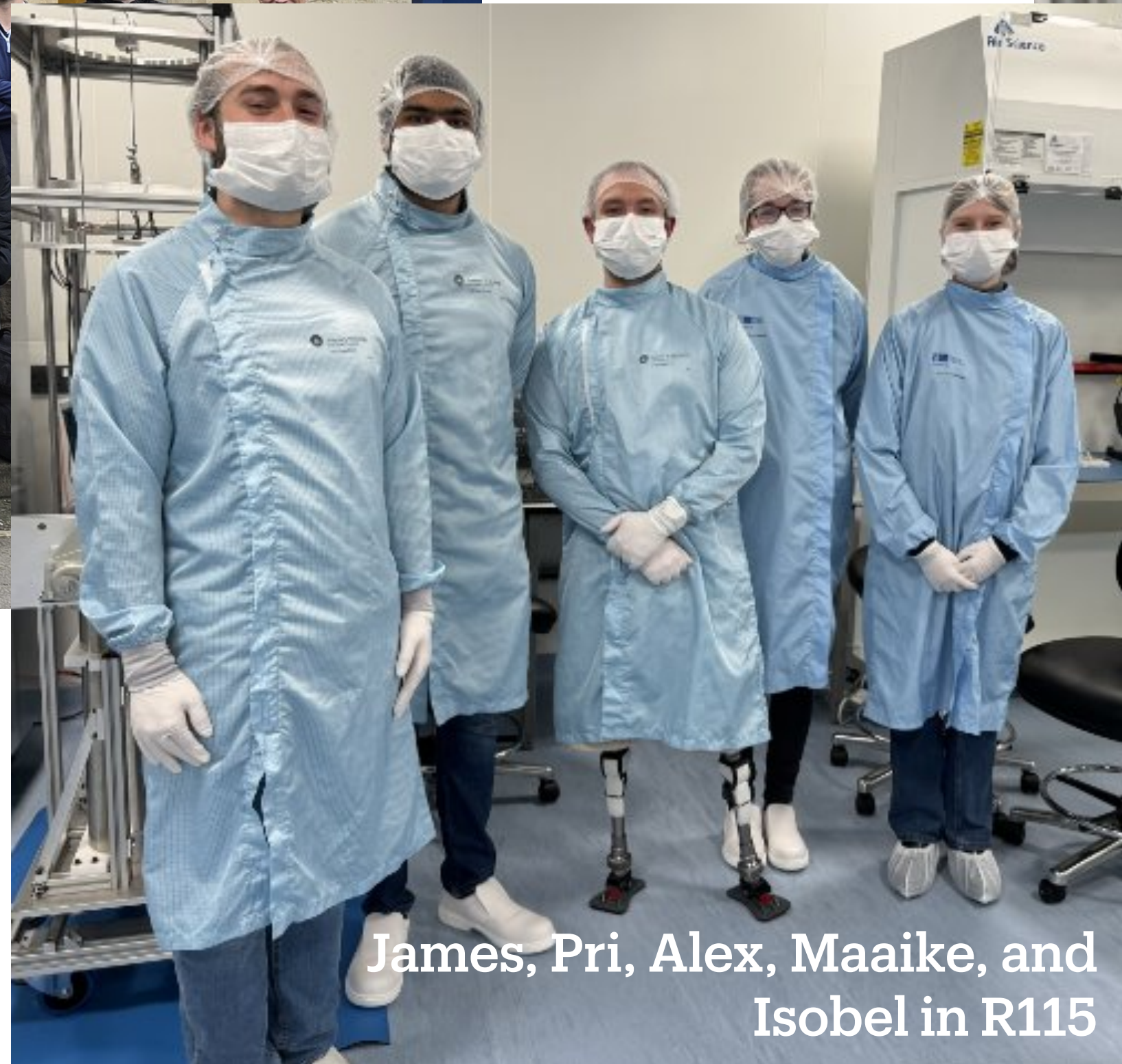
DarkSide-20k: broad-band search for particle dark matter from keV to Planck-scale masses.

QUEST-DMC: search for light dark matter motivated in asymmetric dark matter models.

The Team at RAL is Growing!



Jocelyn, Ashlea, Pri, James, Maike, and Isobel at DarkSide-UK meeting, 11/24



James, Pri, Alex, Maaike, and Isobel in R115



Dan & James in R115

Jocelyn: Seconded to RAL @ 50% from 2024
Ashlea: New FLF joined in Sept '24 + 2 new PDRAs to be recruited next year
Maike & Isobel: PPD graduates (2024)
Pritindra: joint Oxford-PPD student (2022)

TD Collaborators: John Lipp (Pritindra's co-supervisor), James Hollingham, Dan Gorman, Alex Dainty.

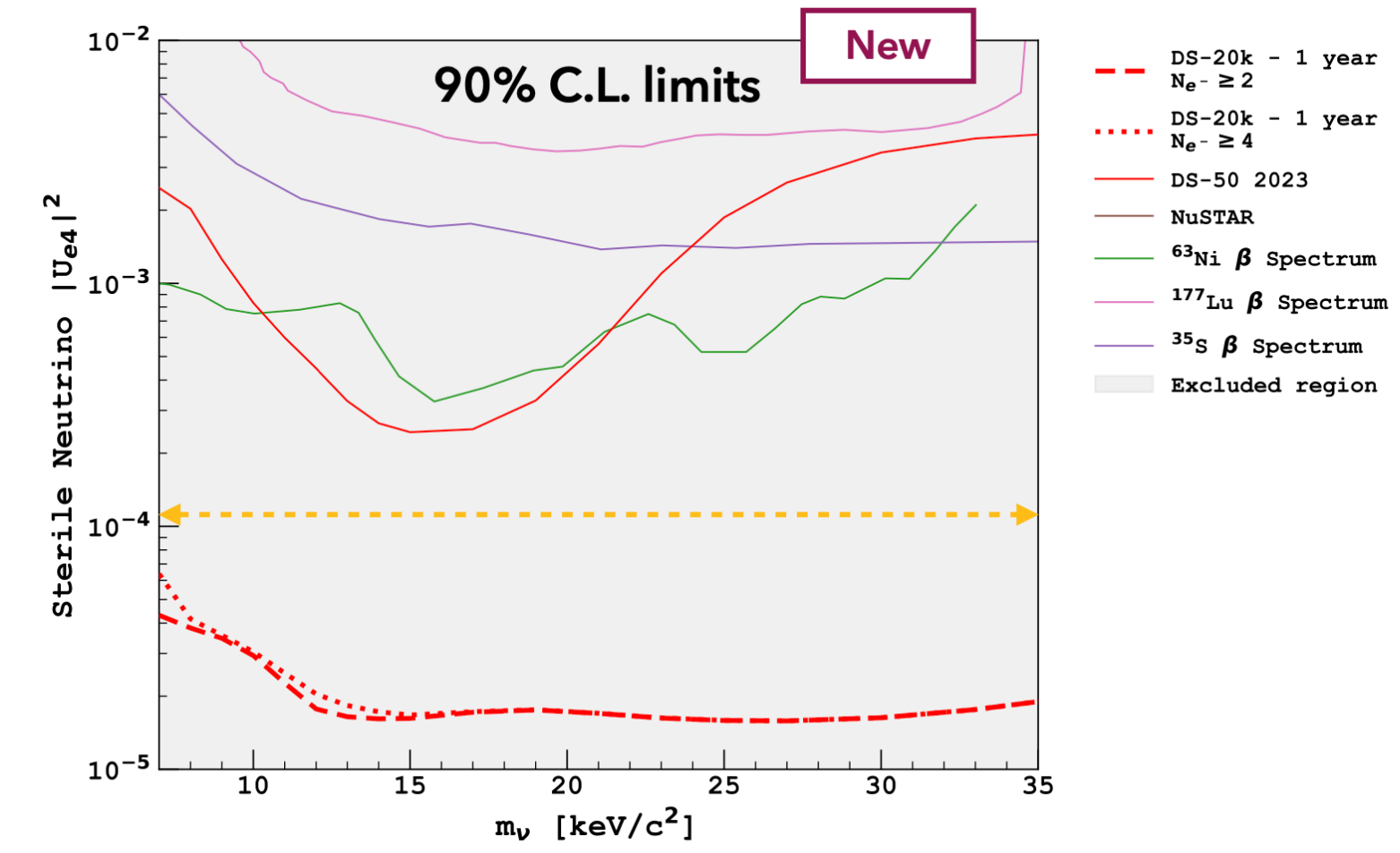
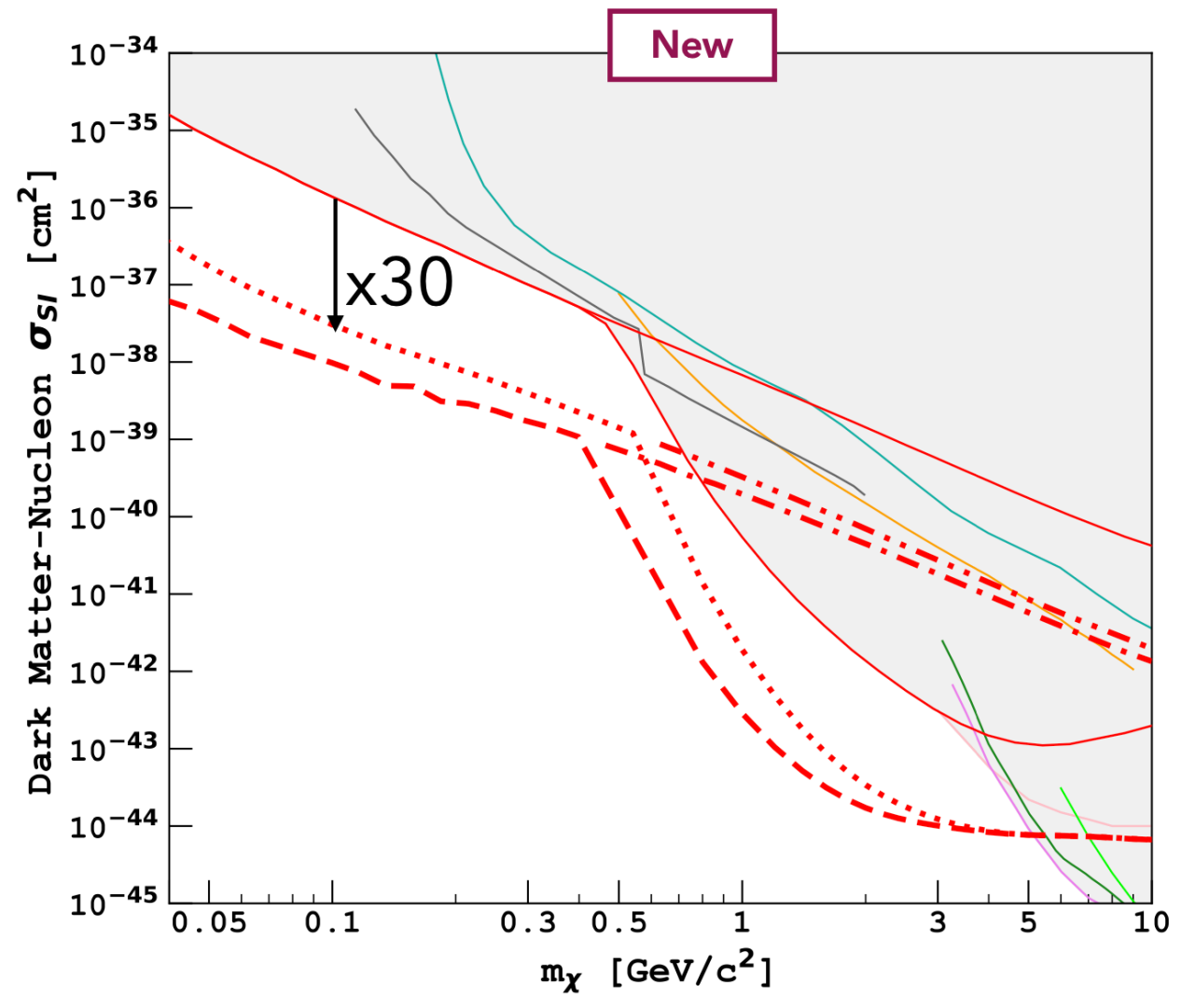
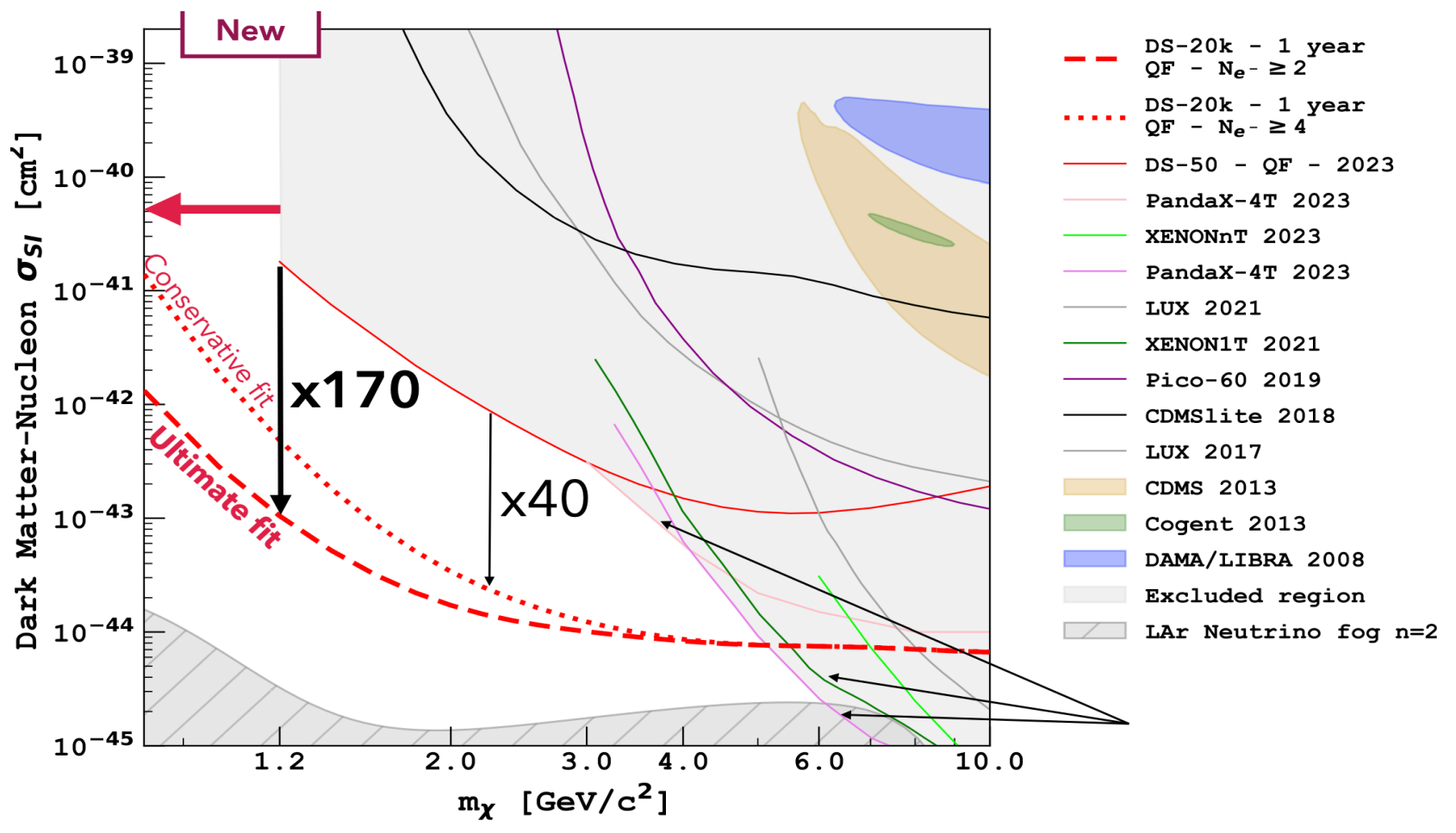
DarkSide-20k is on the nice list!

Six papers in '24 on detector sub-system construction and light dark matter reach for range of beyond-WIMP models (*Nature Comms*).

Benchmarking the design of the cryogenics system for the underground argon in DarkSide-20k #1
 DarkSide-20k Collaboration • F. Acerbi (Fond. Bruno Kessler, Trento) et al. (Aug 26, 2024)
 e-Print: [2408.14071](#) [physics.ins-det]

DarkSide-20k sensitivity to light dark matter particles
 DarkSide-20k Collaboration • F. Acerbi (Fond. Bruno Kessler, Trento) et al. (Jul 8, 2024)
 e-Print: [2407.05813](#) [hep-ex]

Temperature-Dependent Photoluminescence of PEDOT:PSS for use as Transparent Electrodes in the DarkSide-20k Time Projection Chamber #2
 Nicholas Swidinsky (Queen's U., Kingston), Emma Ellingwood (Queen's U., Kingston), Jonathan Hucker (Queen's U., Kingston), Peter Skensved (Queen's U., Kingston), Philippe Di Stefano (Queen's U., Kingston) et al. (Jul 10, 2024)
 e-Print: [2407.08075](#) [physics.ins-det]



DarkSide-20k is on the nice list!

Huge progress in construction in 2024!

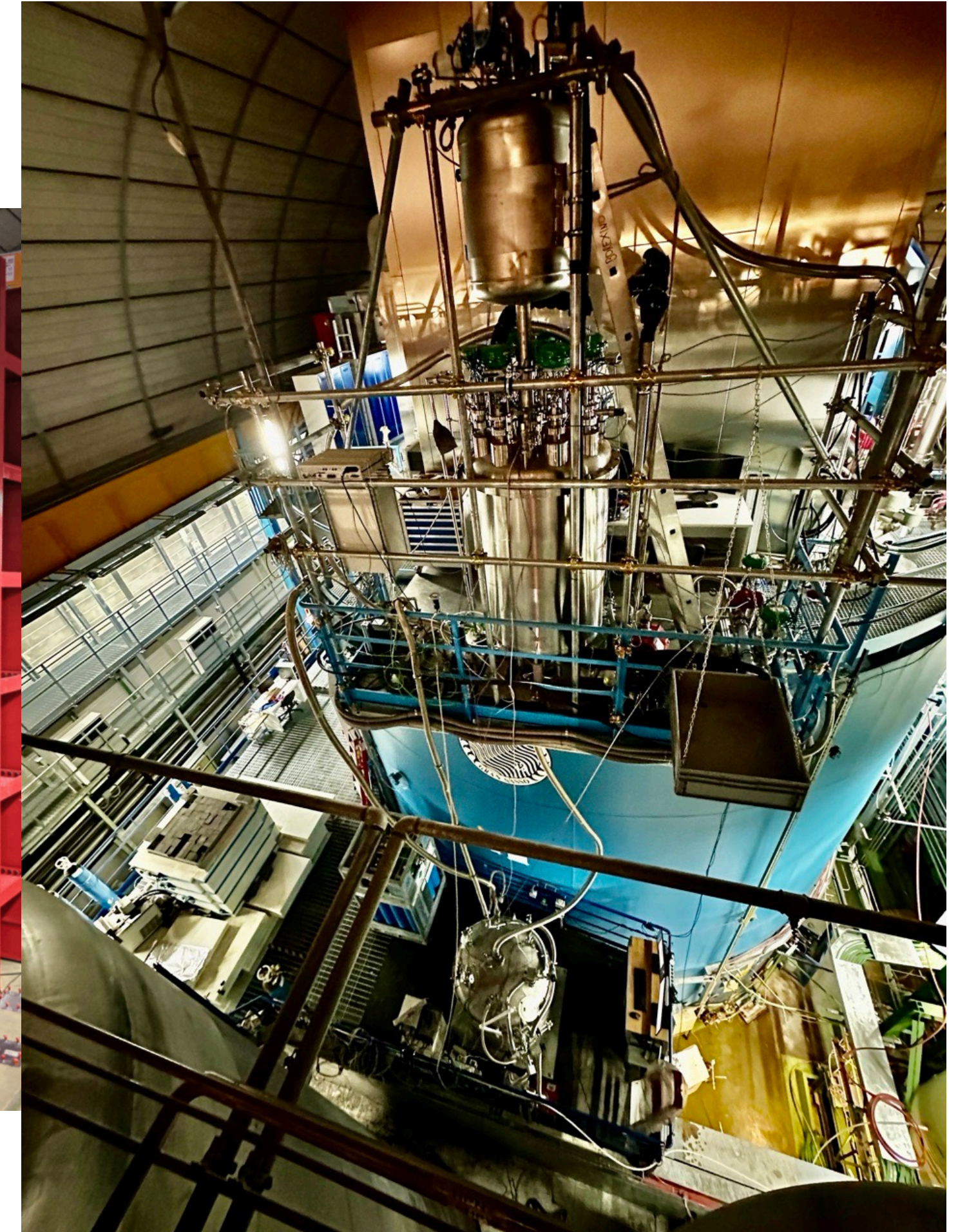


Urania: UAr extraction (Top)

ARIA: UAr purification (Right)



Cryostat complete in Hall C (LNGS)

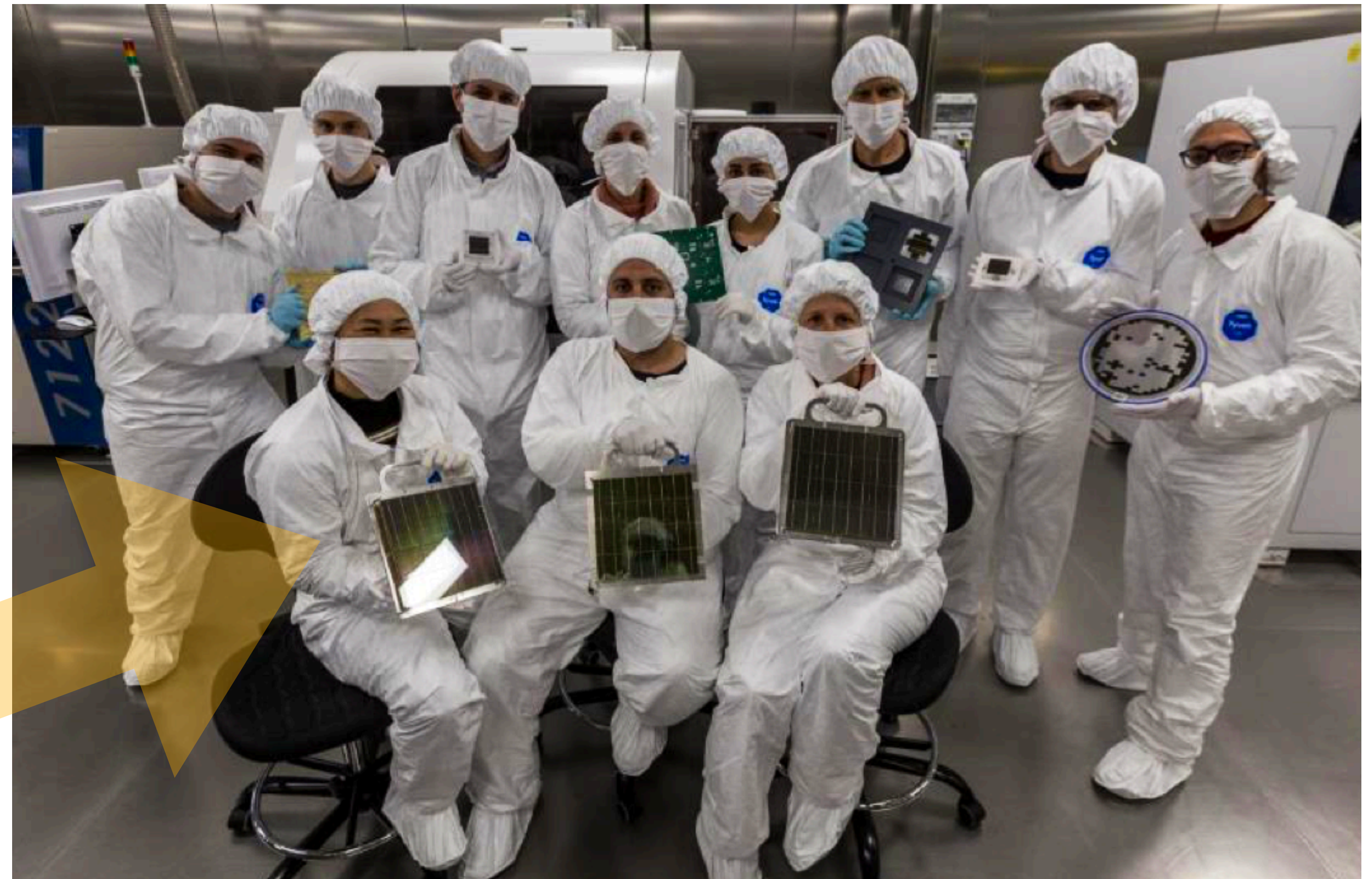
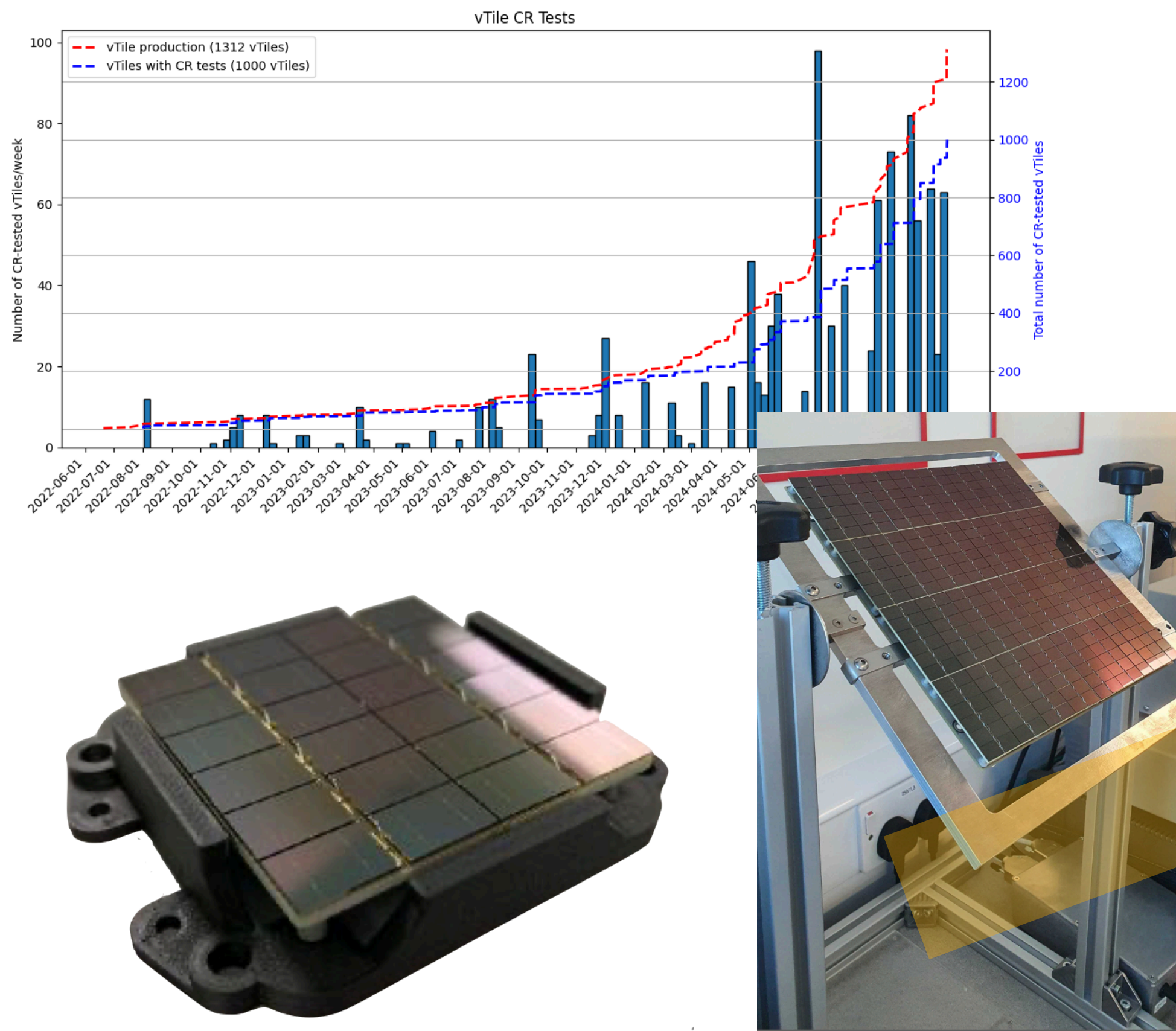


UAr cryogenics system running in Hall C

DarkSide-20k is on the nice list!

UK photosensor production — 7 m² of detectors — is >50% done! >90% yield!

... and they travel almost as much as Santa! Detectors journey from Birmingham to Liverpool, RAL to Oxford to Manchester, Warwick to Liverpool, Lancaster, Edinburgh ... en route to LNGS for installation in DarkSide-20k.



QUEST-DMC is also on the nice list!

1/7 flagship experiments funded by QTFP programme.

Work Package 1

What is the nature of Dark Matter?

Work Package 2

How did the early universe evolve?

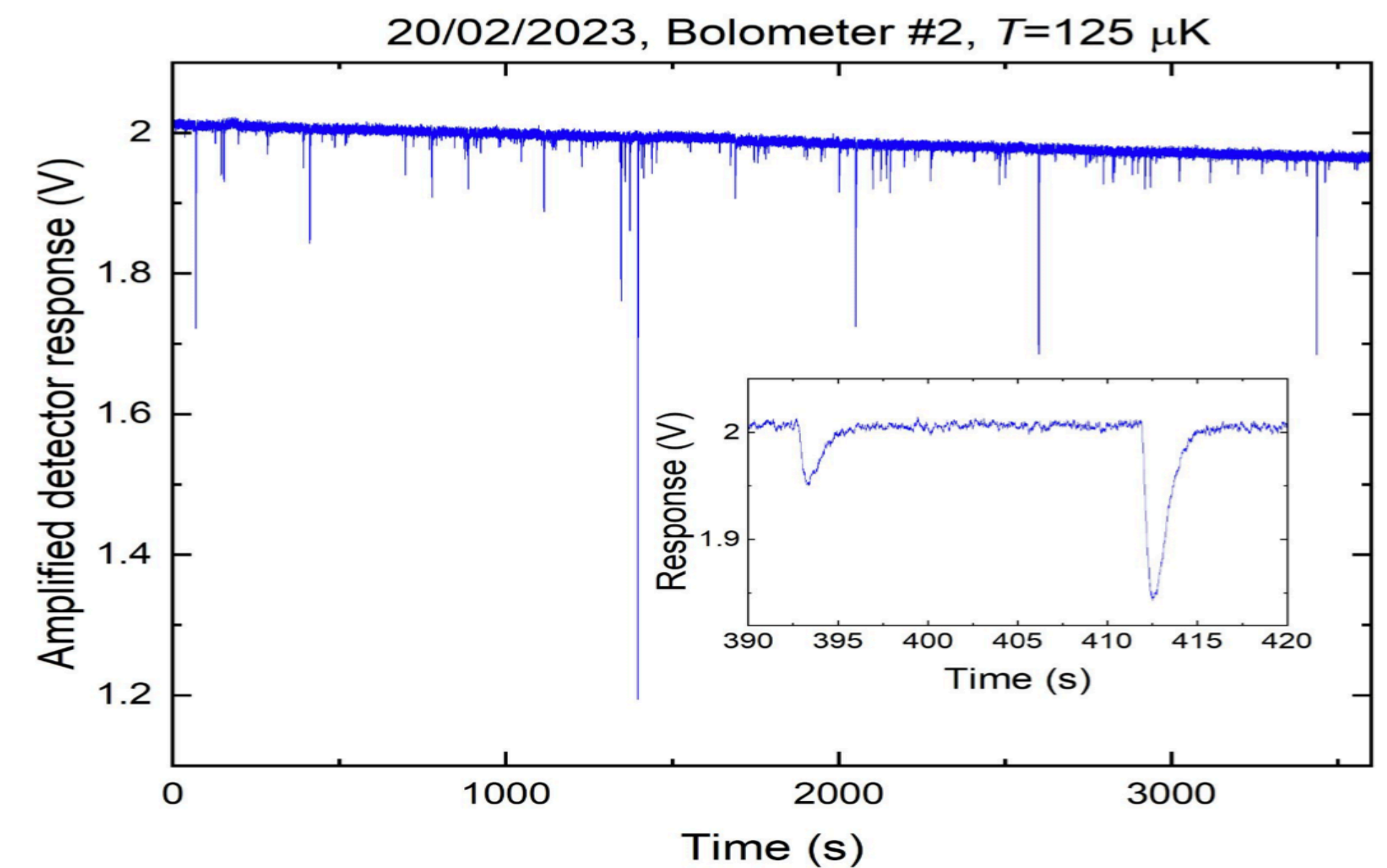
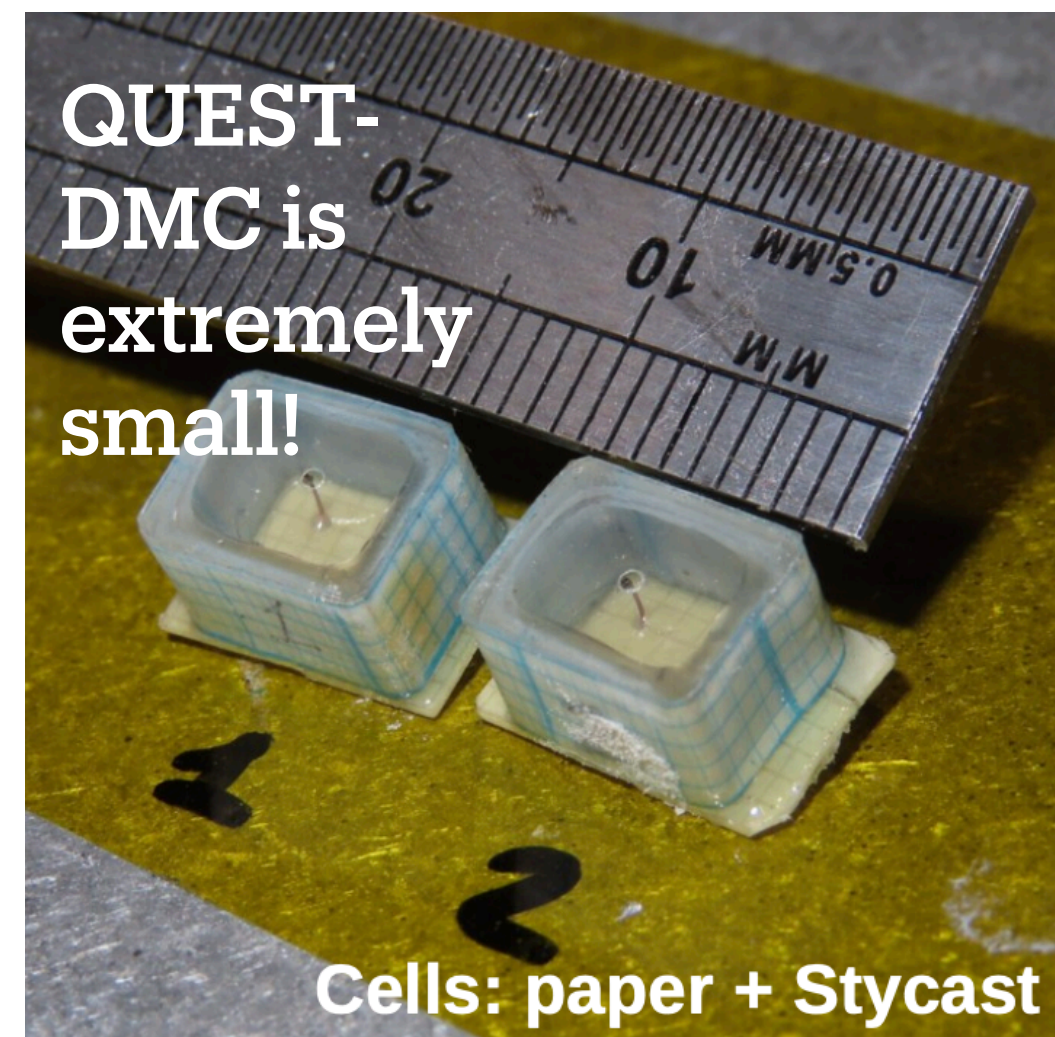
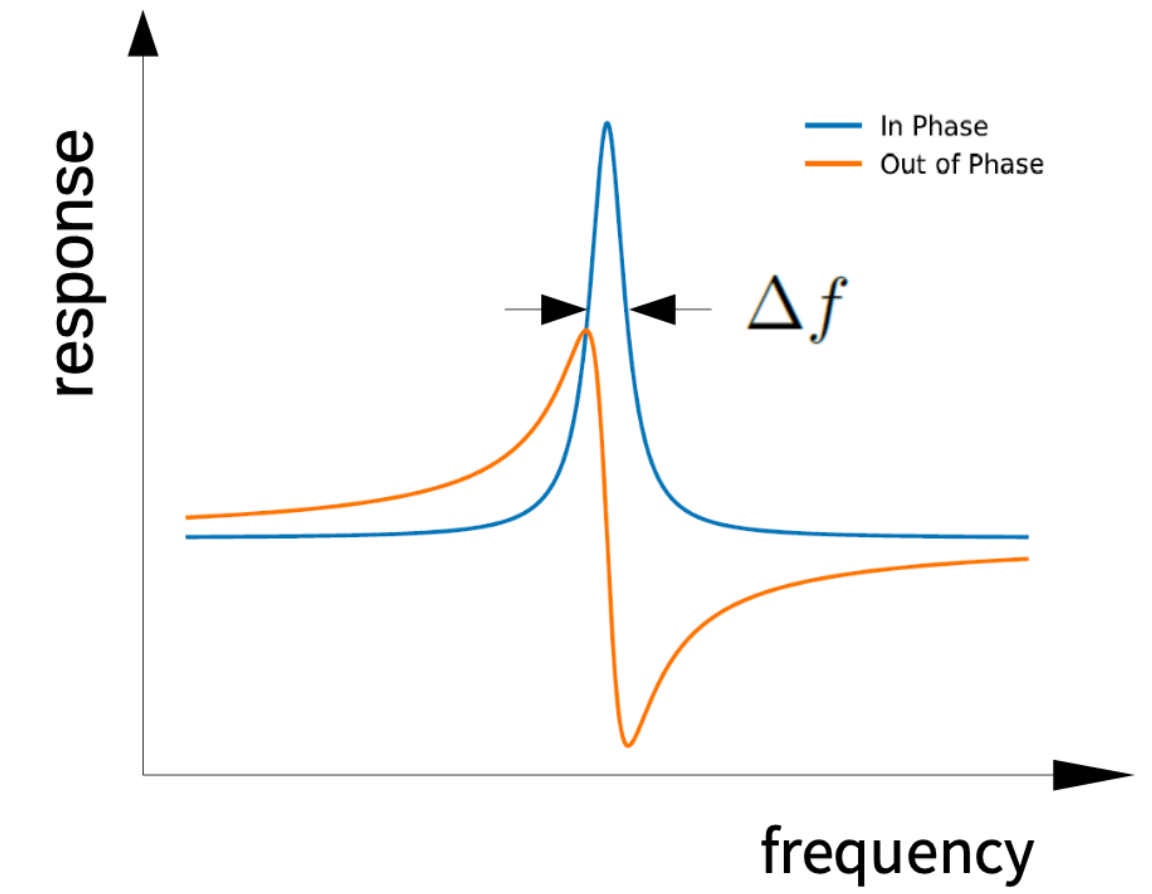
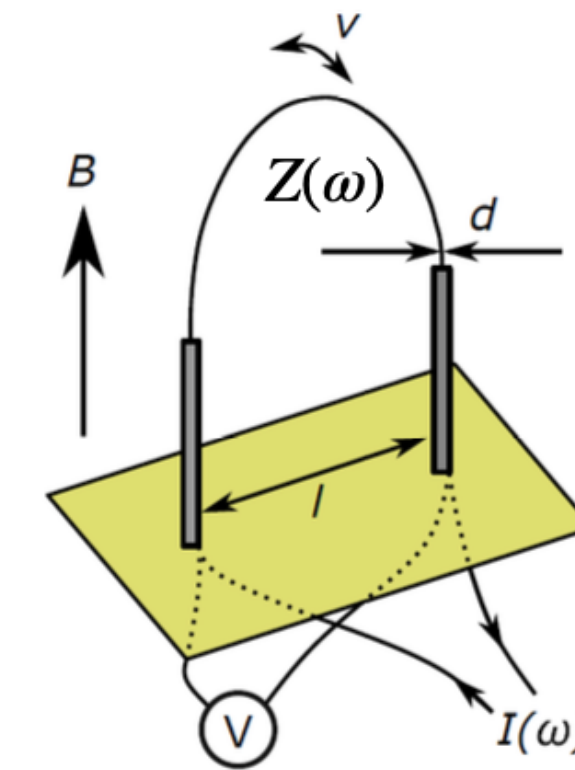
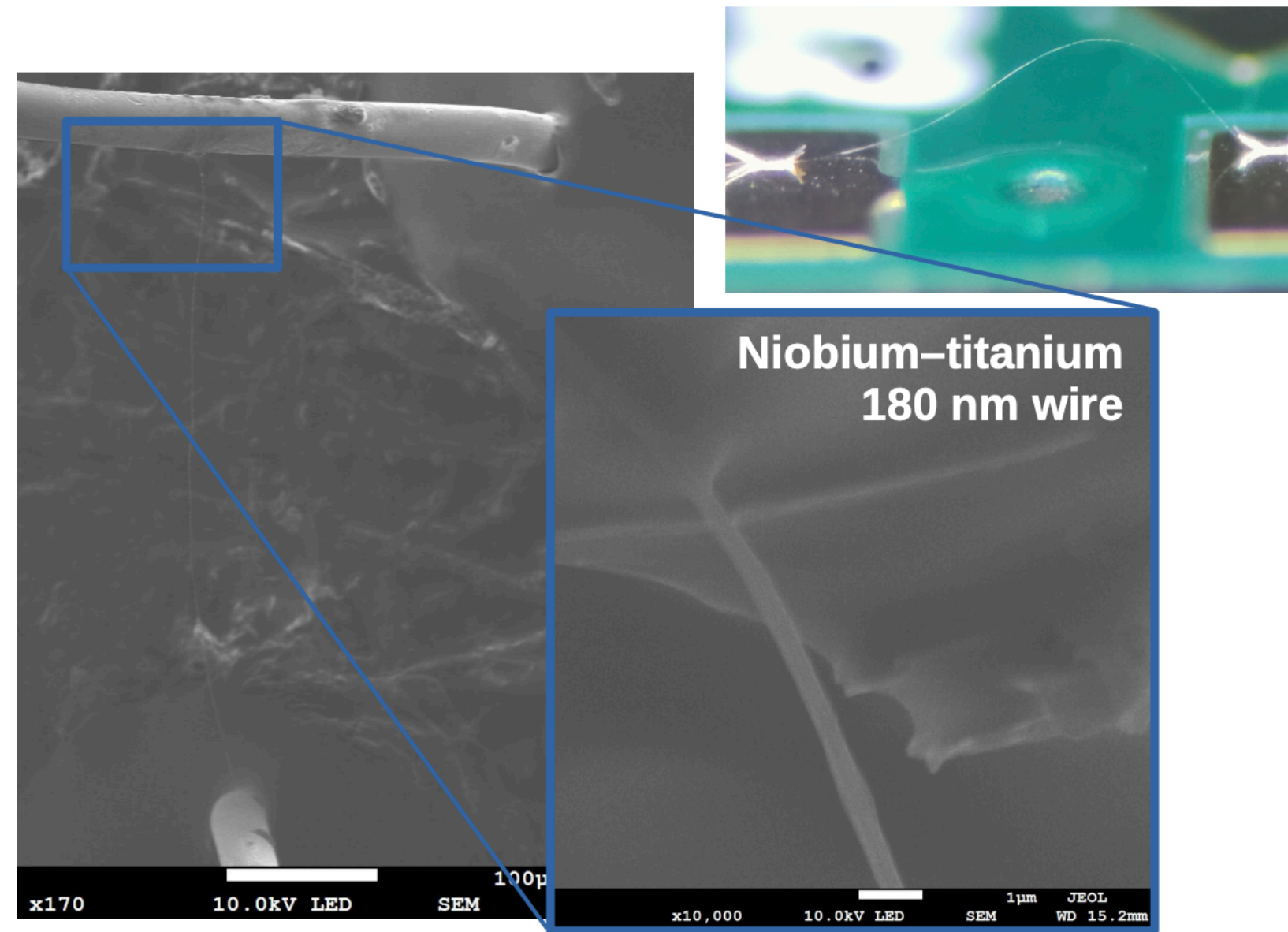
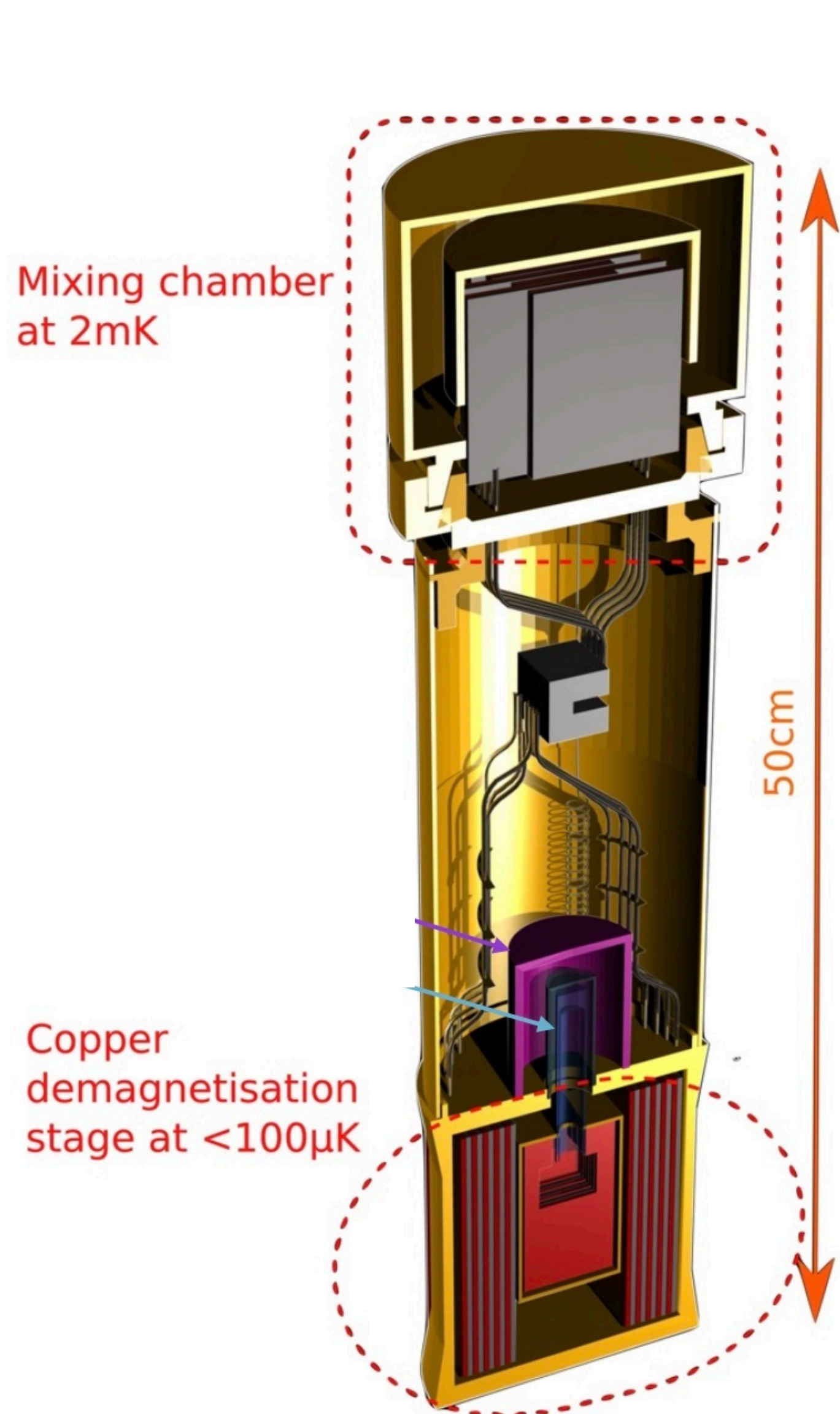


Science and
Technology
Facilities Council



Engineering and
Physical Sciences
Research Council

QUEST-DMC is also on the nice list!



QUEST-DMC is also on the nice list!

Journal of Low Temperature Physics (2024) 215:465–476
<https://doi.org/10.1007/s10909-024-03142-w>

QUEST-DMC: Background Modelling and Resulting Heat Deposit for a Superfluid Helium-3 Bolometer

S. Autti¹ · A. Casey² · N. Eng² · N. Darvishi² · P. Franchini^{1,2} · R. P. Haley¹ · P. J. Heikkinen² · A. Kemp³ · E. Leason^{2,3} · L. V. Levitin² · J. Monroe³ · J. March-Russel³ · M. T. Noble¹ · J. R. Prance¹ · X. Rojas² · T. Salmon¹ · J. Saunders¹ · R. Smith¹ · M. D. Thompson¹ · V. Tsepelin¹ · S. M. West² · L. Whitehead¹ · K. Zhang⁴ · D. E. Zmiev¹

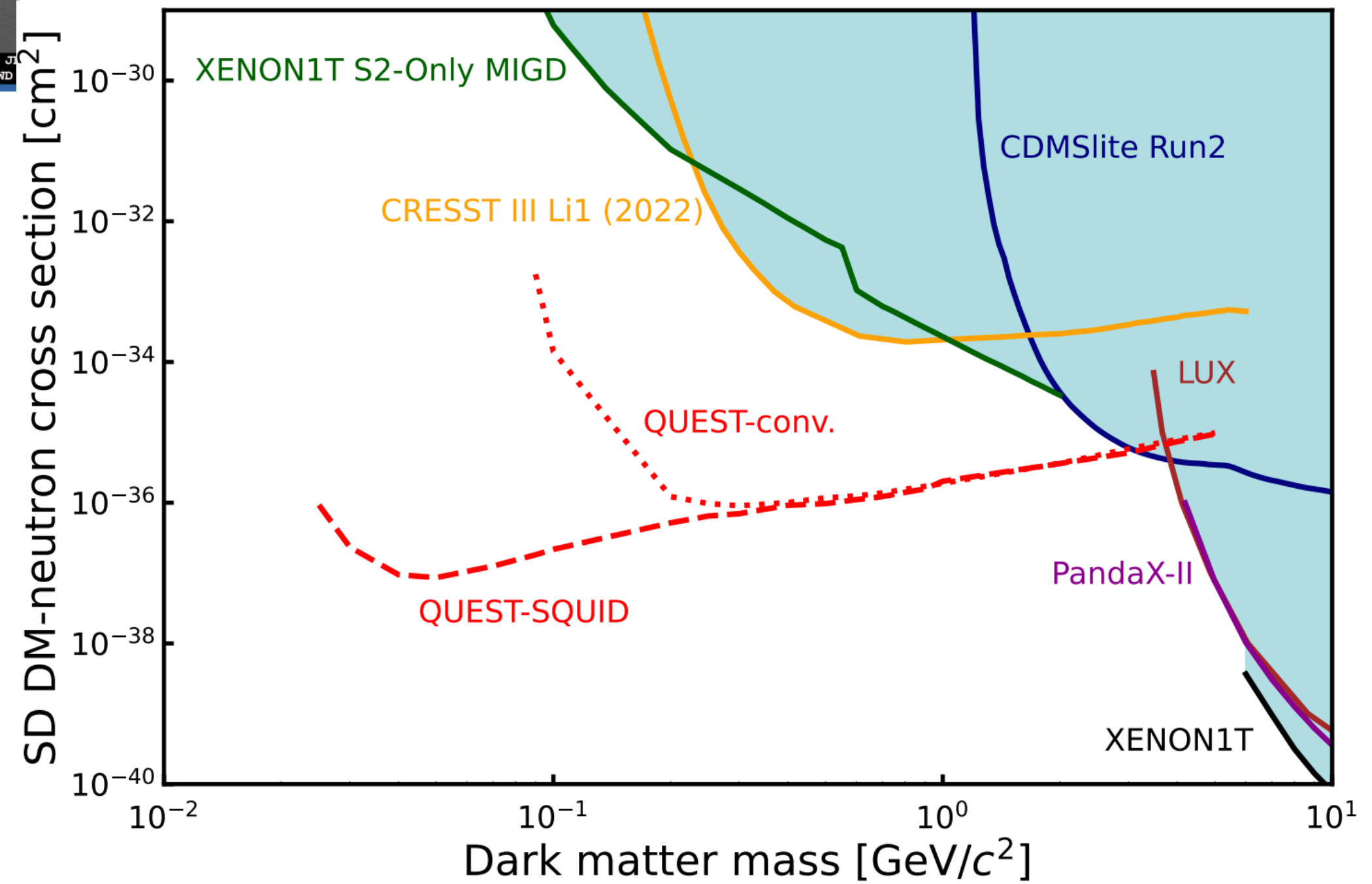
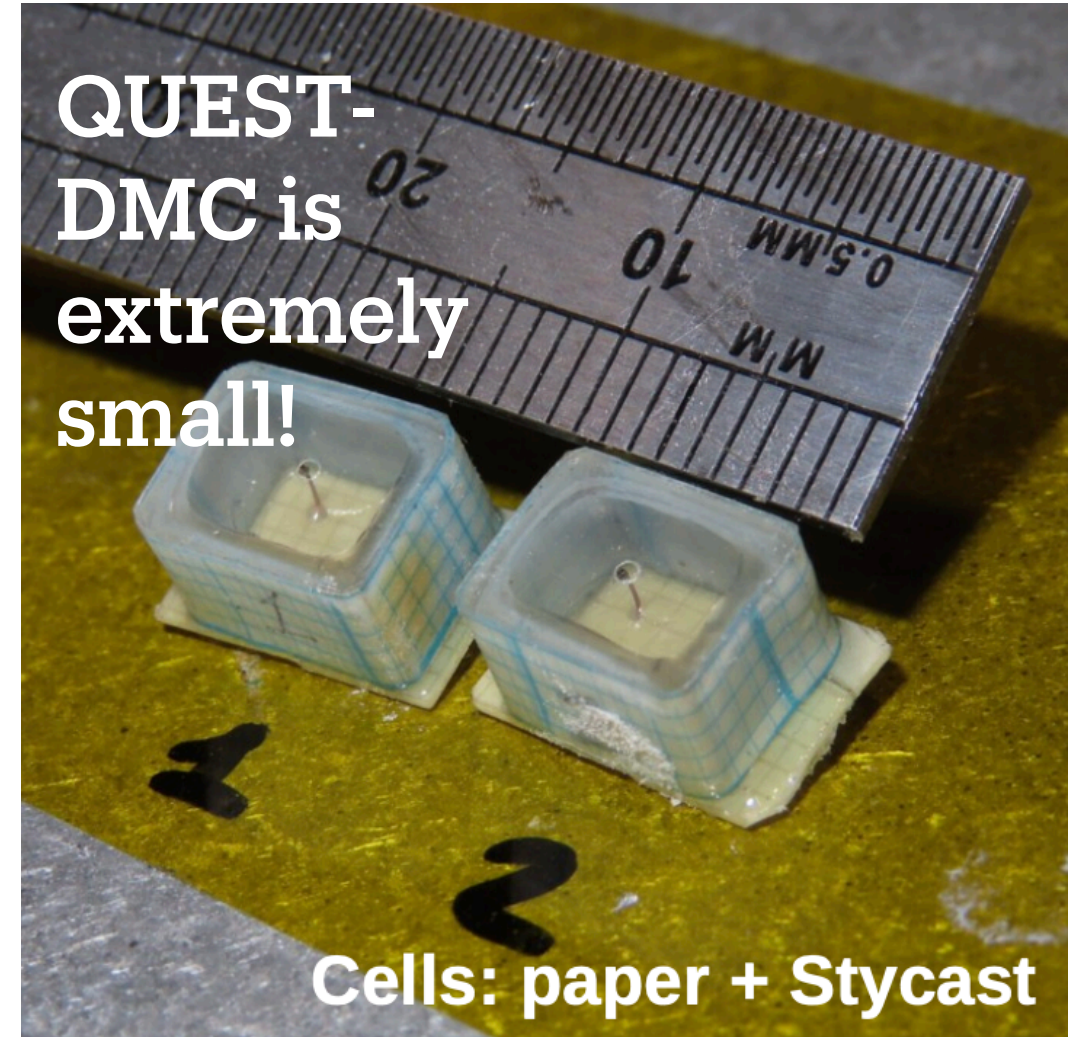
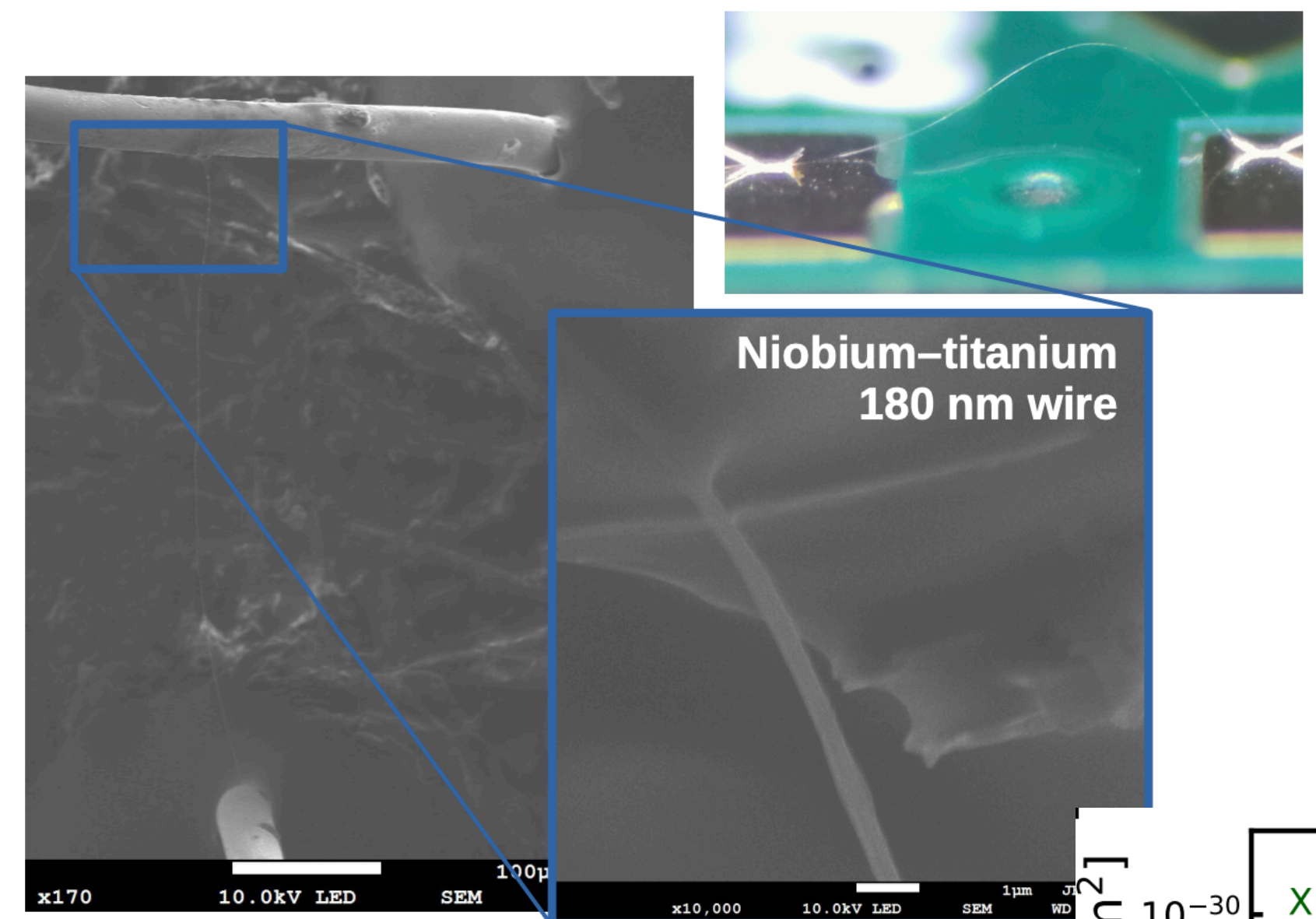
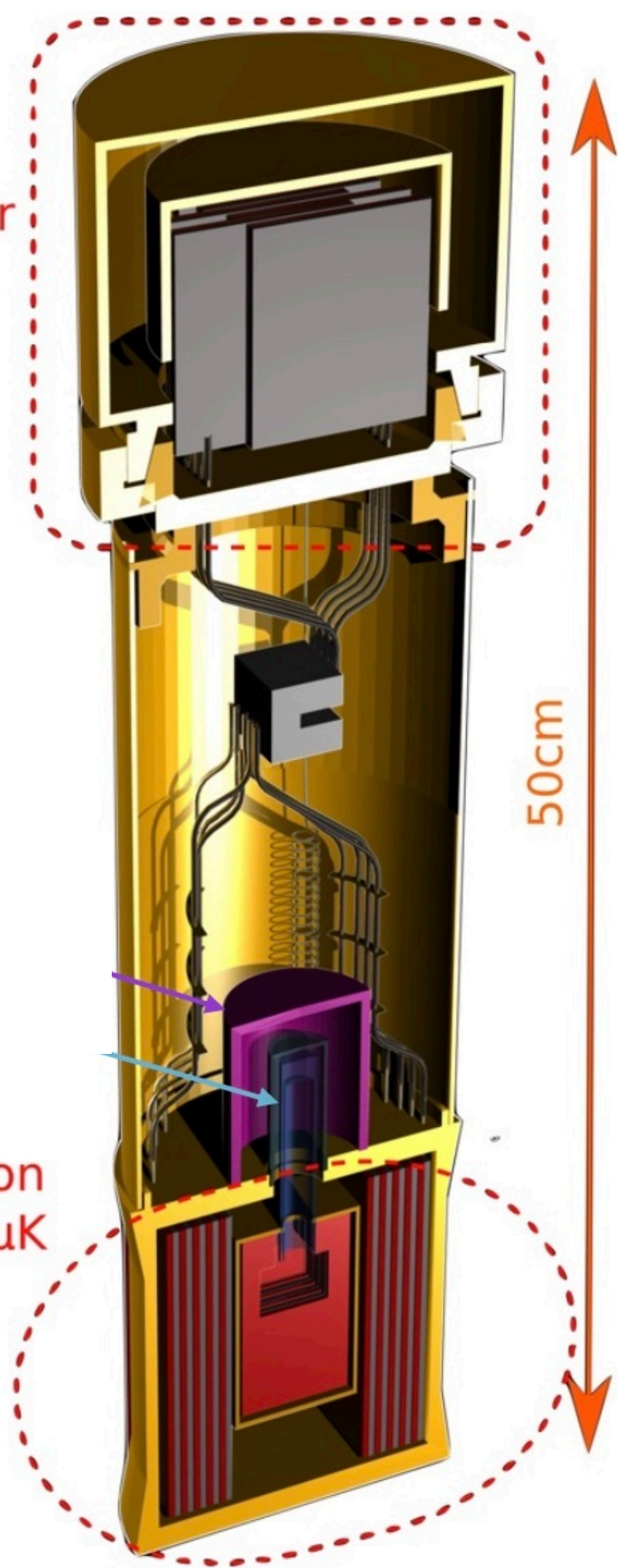
Long nanomechanical resonators with circular cross-section

Samuli Autti (Lancaster U.), Andrew Casey (Royal Holloway, U. of London), Marie Connelly (Lancaster U.), Neda Darvishi (Royal Holloway, U. of London), Paolo Franchini (Royal Holloway, U. of London) Show All(26)
 Nov 4, 2023

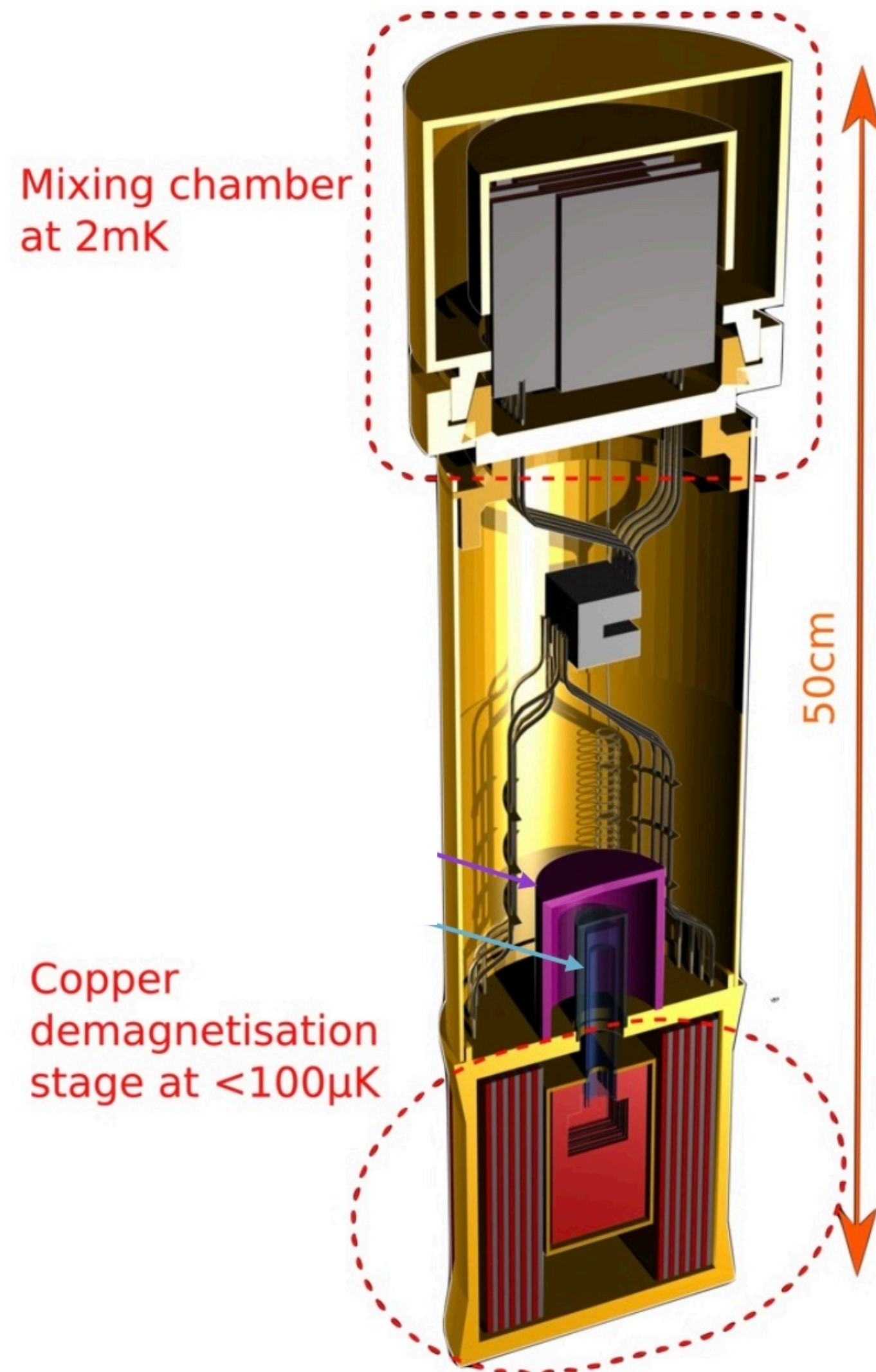
(Eur. Phys. J. C (2024) 84:248)

Mixing chamber at 2mK

Copper demagnetisation stage at <100μK

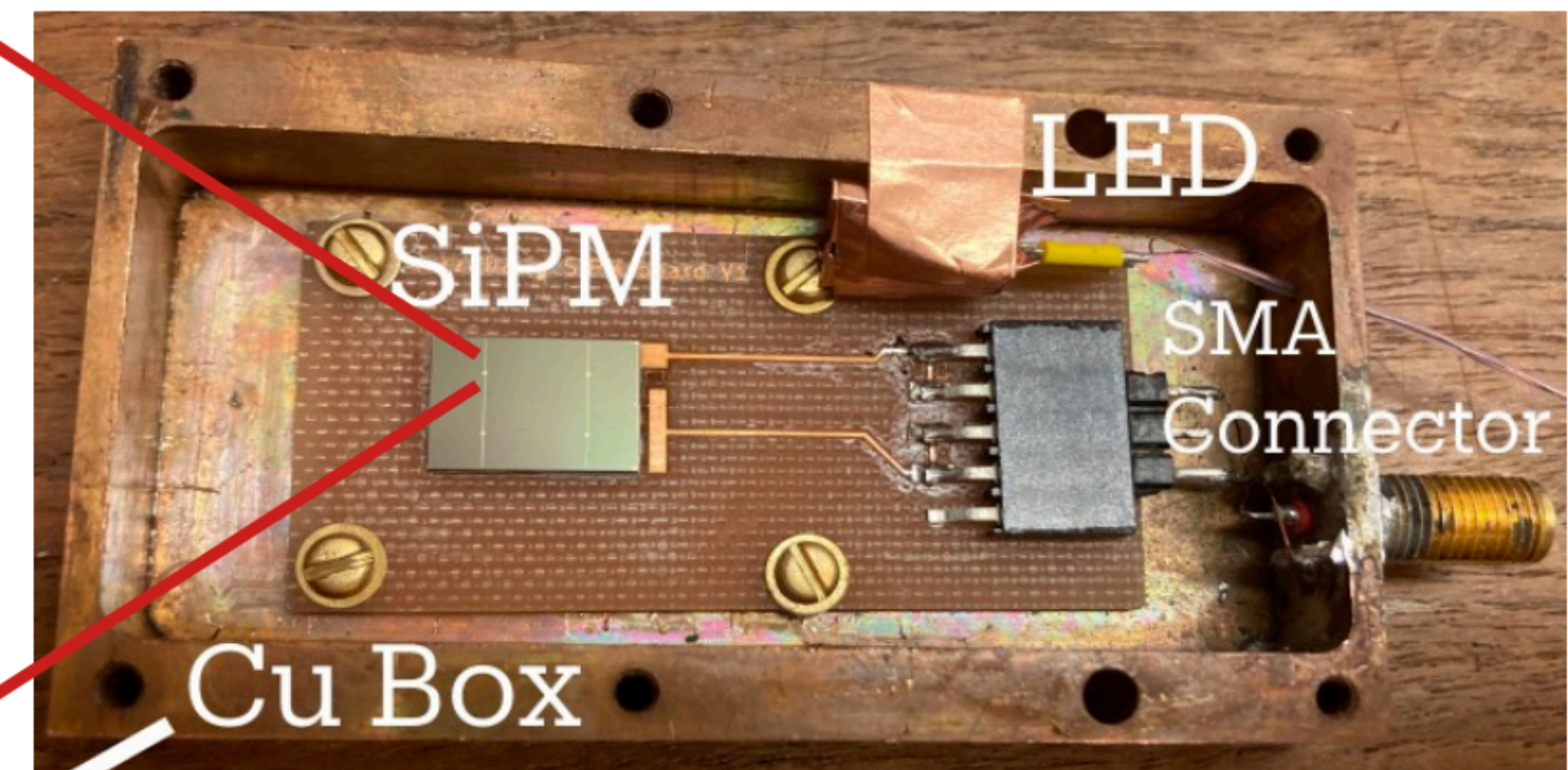
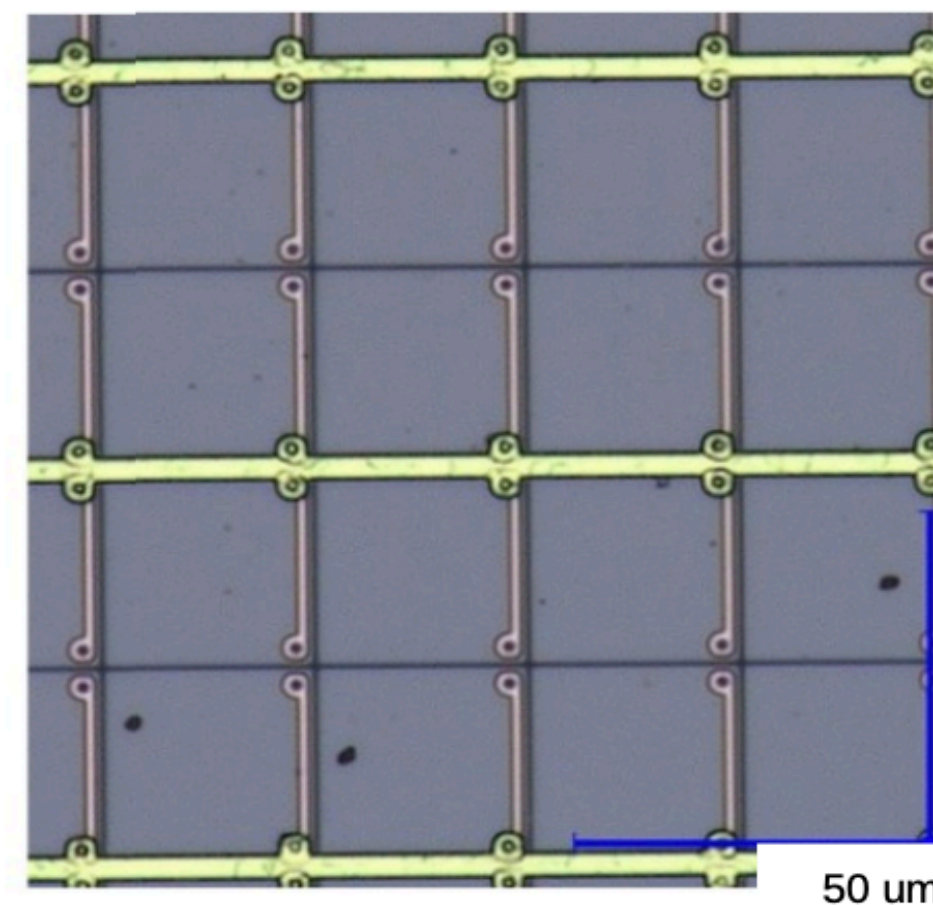
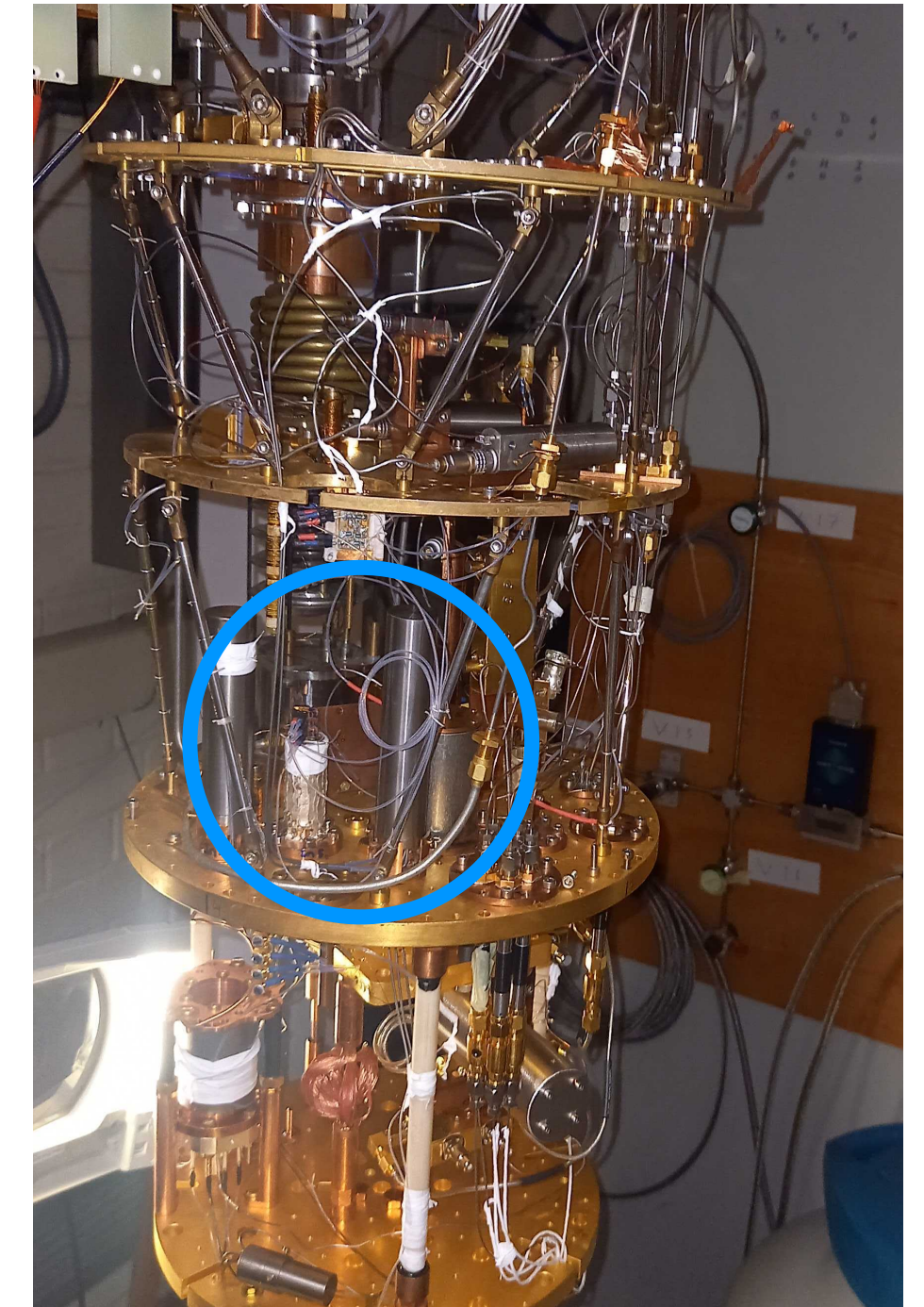


QUEST-DMC is also on the nice list!



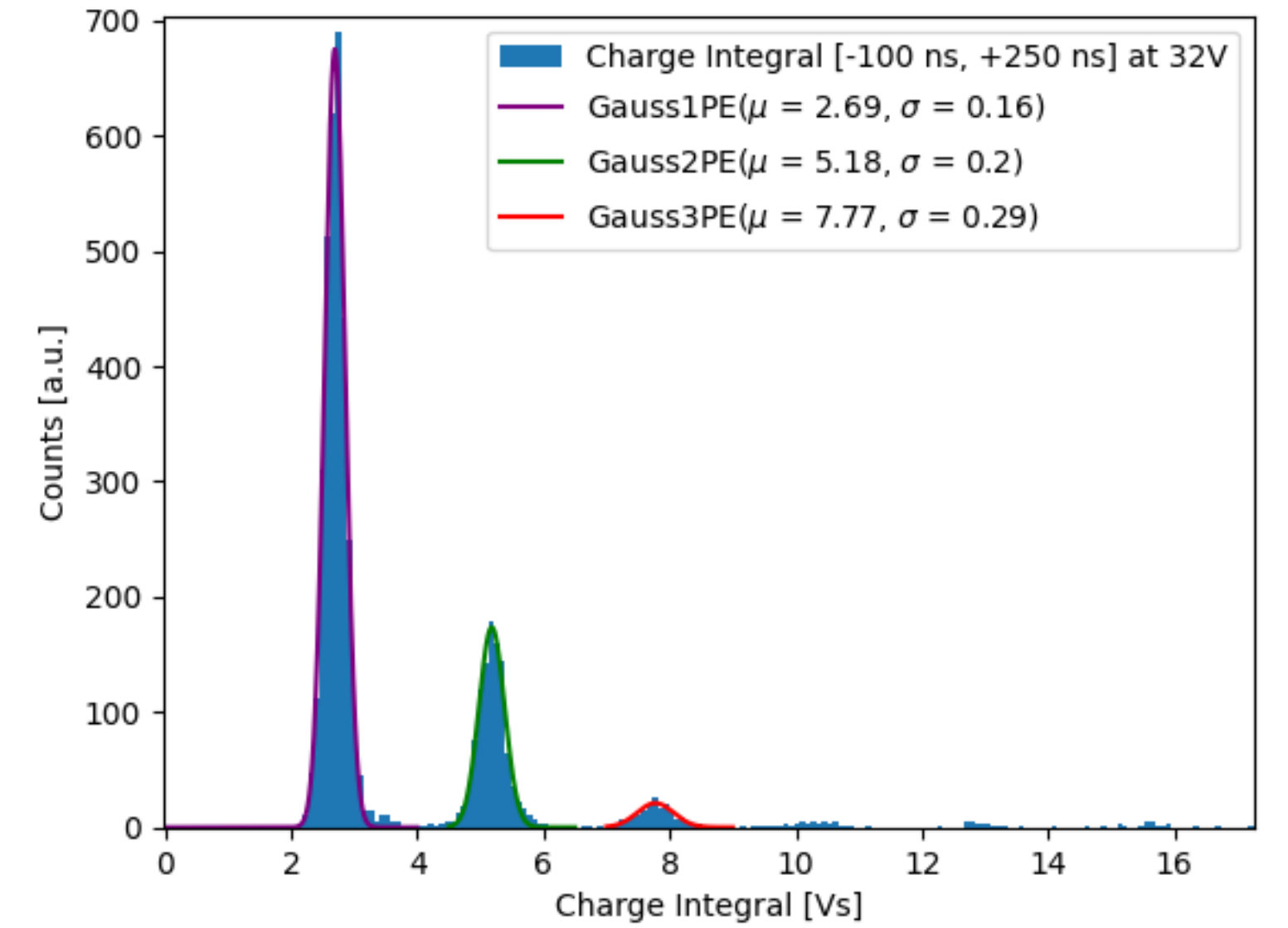
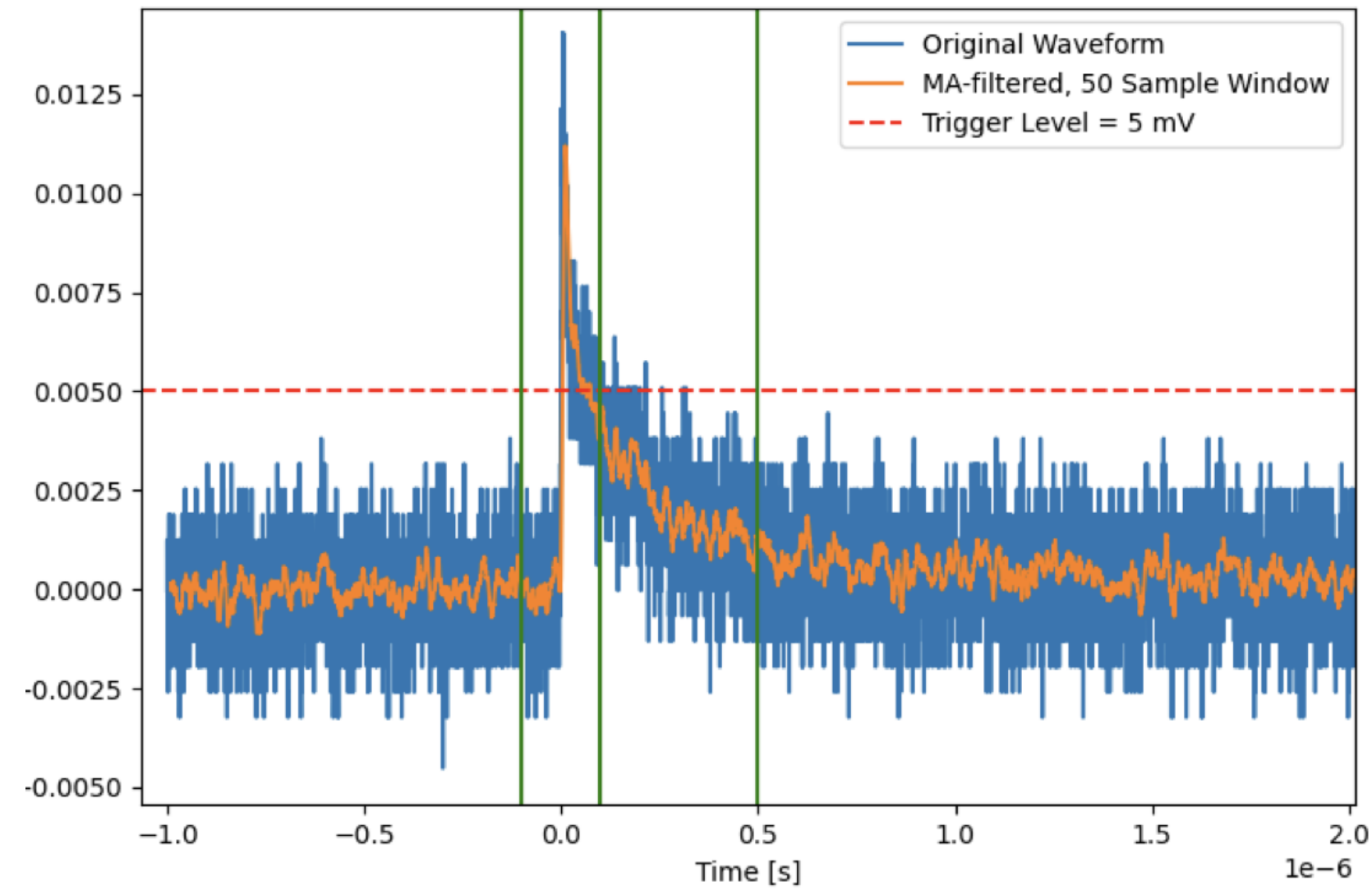
Major limiting background: Cosmic rays!

SiPM R&D for cosmic muon veto detector.



QUEST-DMC is also on the nice list!

Successfully tested
at 17 mK! Lowest in
the literature is 1 K!



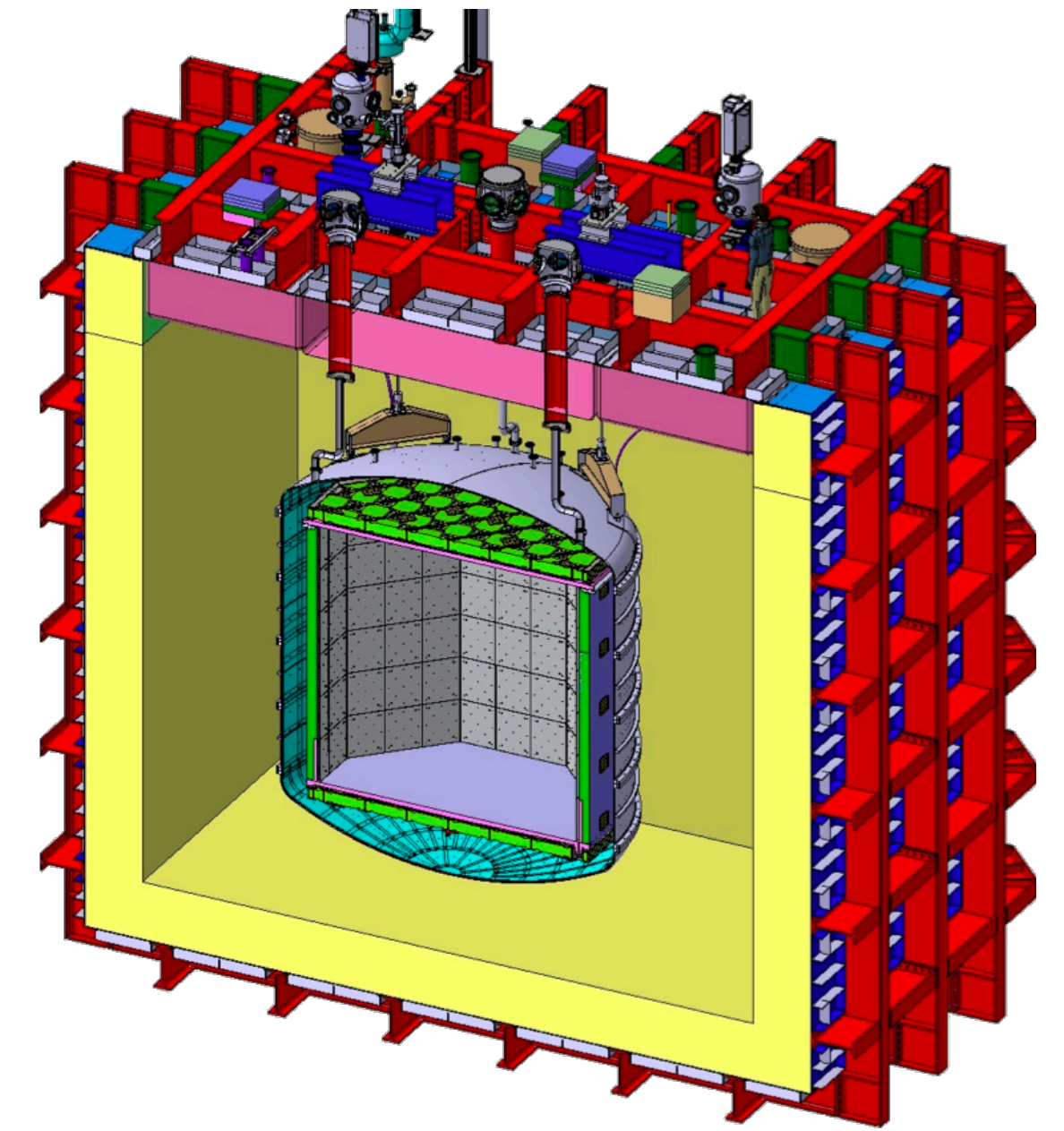
Radiation Impact on Superconducting Qubits (RISQ 2024)

29–31 May 2024
Wilson Hall
America/Chicago timezone

Enter your search term

SQMS + RISQ workshops: Crossover
with quantum technologies.

New Years Resolutions



Deliver 2400 silicon “gifts” to DarkSide-20k and ramp up computing contribution, preparing for commissioning.

Establishing laboratory facility for liquid noble R&D has been in the plans for last 2 years— now we’ve secured funding for RAL to host ULT cryostat/dilution refrigerator. -> opportunity for on-campus science!

Welcome any elves interested to apply their expertise to new challenges... like finding dark matter!



Christmas wish list

Recruit more elves! (Graduates,
PhDs, Post-docs)

Engage in more collaboration
within the North Pole

Find dark matter :)

