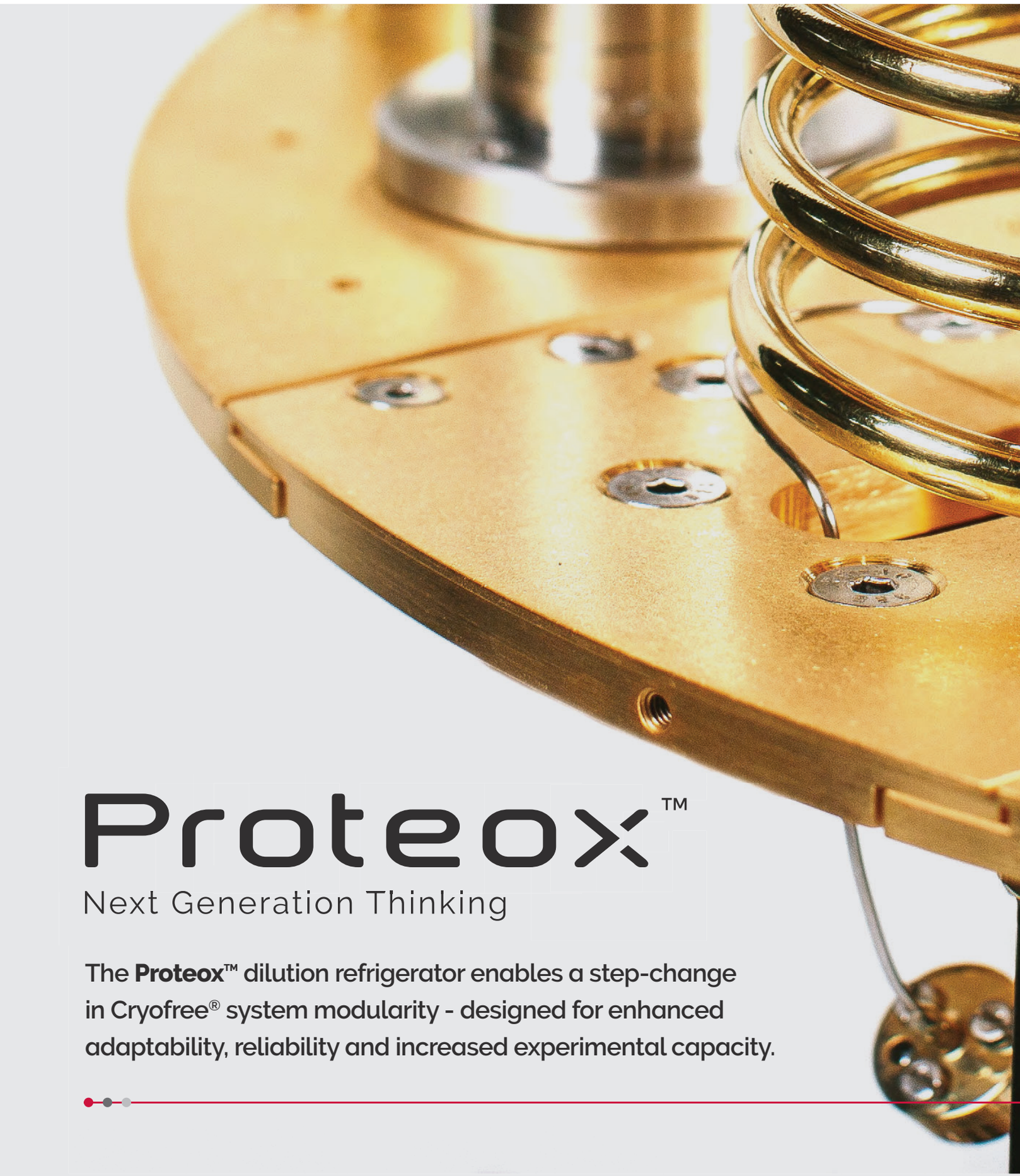
Quantum Design
OXFORD



Proteox™

Next Generation Thinking

The **Proteox**™ dilution refrigerator enables a step-change in Cryofree® system modularity - designed for enhanced adaptability, reliability and increased experimental capacity.

Maximise system value

Customisable, self-supporting Secondary Insert enhances adaptability to varied application requirements and enables rapid exchange of full experimental set-ups.

Multi-user and multi-experiment

DC wiring, coaxial wiring, cold electronic components and samples can be fully integrated on to multiple Secondary Inserts for easy removal, modification and exchange.

Future-proof investment

Fully cross-compatible and upgradeable Secondary Inserts can be exchanged between current (ProteoxMX or ProteoxLX) and future systems in the Proteox family.

Greater control

Patented gas gap heat switch technology is leveraged to provide active control.

Fast, tuneable cool down

When combined with our bottom loader technology, it enables rapid cool down of sample pucks from 300 K.

High temperature operation

With independent control of the experimental plate in excess of 30 K with magnet at full field and fast recovery to base temperature.

Reliability and convenience

New gas handling system delivers increased reliability and longer service intervals. This is combined with a new, powerful software control system.

Simple, powerful software

- Web-based, platform-independent control software
- Published API interface allows full programmatic control
- Event log tracking
- Powerful system logfile visualisation
- Smart session management for multi-user access
- Secure database for logging of system data
- Step-by step wizard for guiding manual processes.

Unlock new applications

Increased capacity for components, experimental services and sample mounting to facilitate qubit scale-up and QIP applications.

High input/output capability

Enables high input/output applications through abundant line-of-sight (LOS) access.

Extensive experimental volume

Large diameter mixing chamber plate, combined with increased plate spacing.

The Proteox™ dilution refrigerator enables a step change in Cryofree® system modularity - designed for enhanced adaptability, reliability and increased experimental capacity.

The Proteox™ Family

ProteoxMX

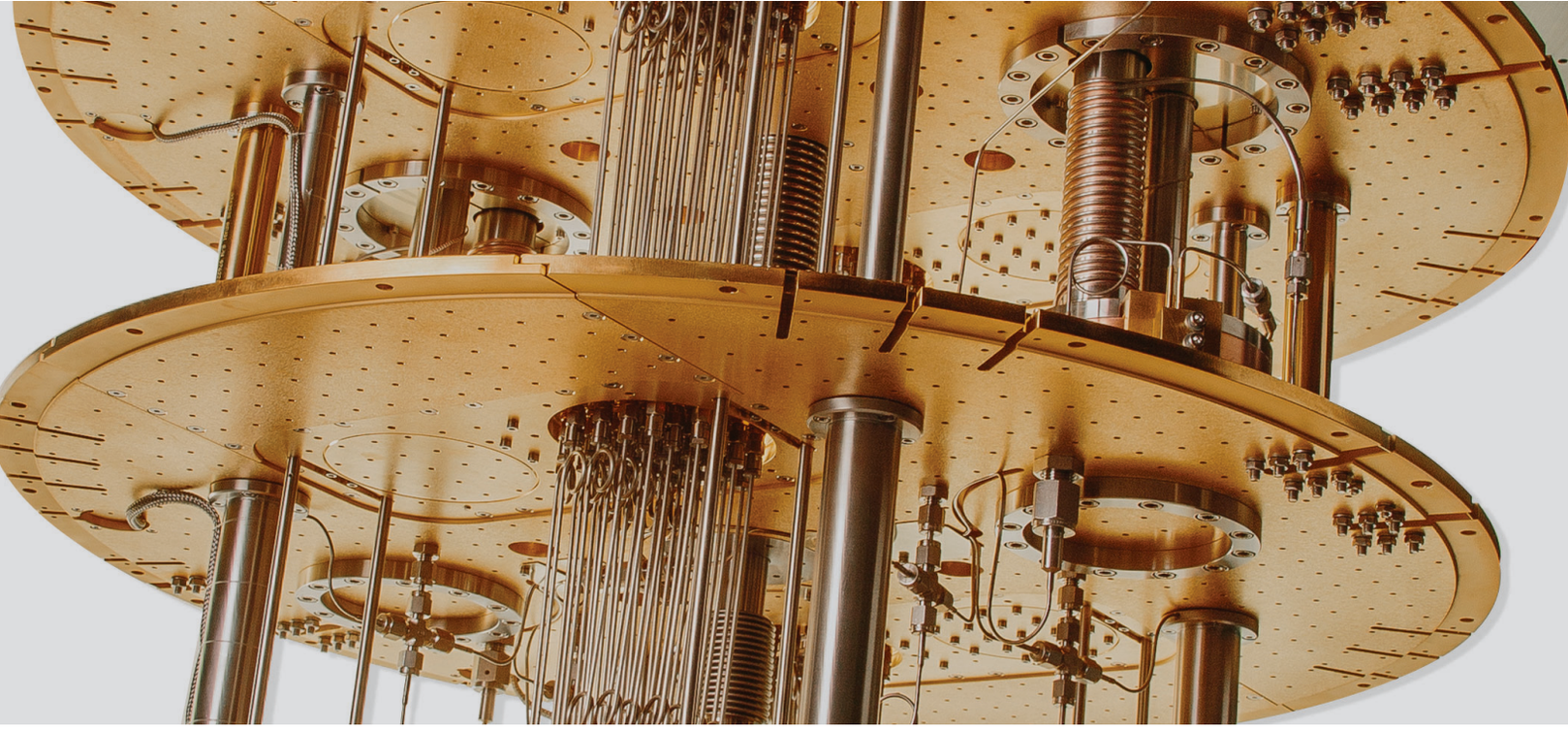
The largest in its class dilution refrigerator with extensive capacity for components, experimental services and sample mounting for high input/output applications.

ProteoxLX

Providing maximum qubit counts with large sample space and ample coaxial capacity for quantum computing scale-up.

Proteox5mK

The world's coldest, continuous, cryogen-free dilution refrigerator, providing ultra-low base temperature of < 5 mK and high cooling power of > 25 µW at 20 mK.



The **Proteox™** Secondary Insert is a customisable, self-supporting module to enable installation and exchange of full experimental set-ups.

Overview

Moving beyond standard access ports, the Secondary Insert can accommodate full experimental set-ups, including DC wiring, coaxial wiring and signal conditioning components.

- Flexible, modular format enhances adaptability to varied application requirements
- Large 117 × 252 mm rectangular LOS access port. This can be configured as a single customisable plate, or with 2 × ISO100 ports and a range of standard wiring options.

Standard Configurations

ISO100 Port Configurations: A standard configuration of 2 x ISO100 ports, with multiple ISO100 options to provide experimental wiring.

- Up to 37 UT85 coax per ISO100 port
- Blanking plate option with tapped M3 grid array for mounting of experimental hardware.

Optional Blank Plates Instead Of Secondary Insert

- If a Secondary Insert is not required, there is an optional blanking plate with tapped M3 grid array for useable experimental space.

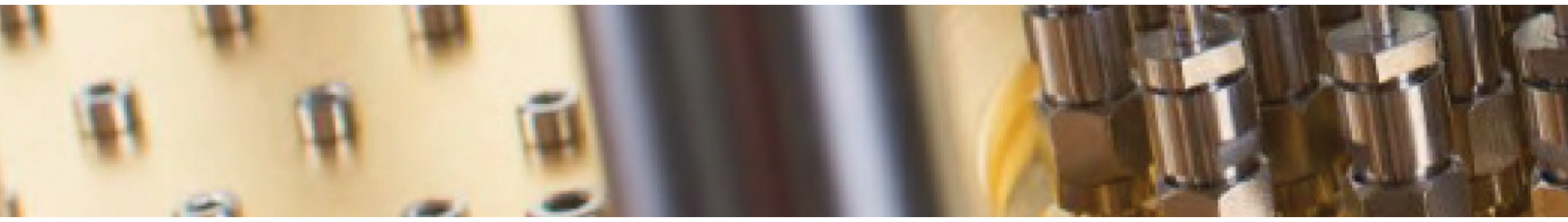
Custom Configuration

- Components can be directly mounted onto the Secondary Insert plate, creating a platform tailored to your experiment
- Custom configurations enable up to 128 UT85 coax lines per Secondary Insert
- Customisable insert for experimental wiring optimisation
- Components mounted directly onto the SI to maximise space.

Cryogenic Low Noise Amplifiers And RF Components.

A selection of low noise amplifiers, isolators and circulators can be integrated into the wiring configuration.

- Custom bracketry for mounting hardware - amplifiers, isolators etc
- Signal conditioning mounted in-line to maximise the number of components.



Key Specifications

Features / Specs	MX300	MX450
Base temperature	< 10 mK	< 10 mK
Cooling power at 20 mK	> 10 µW	> 12 µW
Cooling power at 100 mK	Guaranteed: > 300 µW Expected: > 350 µW	Guaranteed: > 450 µW Expected: > 500 µW
Sample Space Diameter	360 mm	360 mm
Line of Sight Access	1 × Secondary Insert (117 × 252 mm) 2 × KF40, 2 × KF25	1 × Secondary Insert (117 × 252 mm) 2 × KF40, 2 × KF25
PTR Options	1 × 1.35 W, 1.50 W or 1.80 W	1 × 1.35 W, 1.50 W or 1.80 W
Temperature Control Range	10 mK to 30 K with magnet at full field	10 mK to 30 K with magnet at full field
Magnet Options	Standard solenoid 1T to 14T Cancelled solenoid 12 T to 14 T Vector rotate: 6-1-1 T to 9-1-1 T Custom by request	Standard solenoid 1T to 14T Cancelled solenoid 12 T to 14 T Vector rotate: 6-1-1 T to 9-1-1 T Custom by request
Bottom loader Options	60 mm, 96 DC, 22 coax 72 mm, 96 DC, 28 coax Dependent on magnet selection	60 mm, 96 DC, 22 coax 72 mm, 96 DC, 28 coax Dependent on magnet selection
Secondary insert	1 × Secondary Insert (117 × 252 mm) Fully customisable to integrate wiring and signal conditioning	1 × Secondary Insert (117 × 252 mm) Fully customisable to integrate wiring and signal conditioning
Temperature stability	± 1 mK < 100 mK, ± 1 % > 100 mK	± 1 mK < 100 mK, ± 1 % > 100 mK
Helium 3 Requirment	13 L	18 L

LX500	LX900	5mK 900
< 10 mK	< 7 mK	< 5 mK
> 12 µW	> 25 µW	> 25 µW
> 450 µW	> 850 µW	> 850 µW
530 mm	530 mm	360 mm
2 × Secondary Inserts (117 × 252 mm) 4 × KF25	2 × Secondary Inserts (117 × 252 mm) 4 × KF25	1 × ISO100, 1 × KF63 2 × KF40, 2 × KF25
2 × 1.35 W, 1.50 W or 1.80 W	2 × 1.35 W, 1.50 W or 1.80 W	1 × 1.35 W, 1.50 W or 1.80 W
10 mK to 30 K with magnet at full field	7 mK to 30 K with magnet at full field	5 mK to 30 K with magnet at full field
Standard solenoid 1T to 14T Cancelled solenoid 12 T to 14 T Vector rotate: 6-1-1 T to 9-1-1 T Custom by request	Standard solenoid 1T to 14T Cancelled solenoid 12 T to 14 T Vector rotate: 6-1-1 T to 9-1-1 T Custom by request	Standard solenoid 1T to 14T Cancelled solenoid 12 T to 14 T Vector rotate: 6-1-1 T to 9-1-1 T Custom by request
60 mm, 96 DC, 22 coax 72 mm, 96 DC, 28 coax Dependent on magnet selection	60 mm, 96 DC, 22 coax 72 mm, 96 DC, 28 coax Dependent on magnet selection	By request
2 × Secondary Insert (117 × 252 mm) Fully customisable to integrate wiring and signal conditioning	2 × Secondary Insert (117 × 252 mm) Fully customisable to integrate wiring and signal conditioning	None
± 1 mK < 100 mK, ± 1 % > 100 mK	± 1 mK < 100 mK, ± 1 % > 100 mK	± 1 mK < 100 mK, ± 1 % > 100 mK
18 L	50 L	50 L

Proteox Platform

Optimised to provide long term reliability, stability and ease of use.

Software

- Remote access through a web-based, platform-independent control software in addition to local system control
- Automation routines for one button operation
- Full manual control and programmable API interface for custom routines
- Powerful data interrogation and visualisation package with live plotting
- Step-by step wizard for guiding manual processes.

System

- Fully redeveloped new gas handling system to ensure the minimum number of connections and o-ring seals
- Cross-braced stiffened frame that minimises vibration transmission eliminating the need for active damping
- Modular, upgradable platform with cross-compatible magnet systems.

Magnet Technology

In-house design, manufacturing and support of both the dilution refrigerator and the superconducting magnet provides a fully integrated system with unified software control and data logging.

Magnet Technology

- Built-in quench protection circuits
- Bolted current lead connections for easy removal or upgrade
- Integrated sensor for temperature monitoring.

Solenoid magnets

- Range of field strengths from 1 T to 14 T
- Central field homogeneity of 0.1 % over 10 mm D.S.V across the range
- High current, low inductance designs reducing conductor thermal mass and improving cool down times
- Persistent mode operation < 0.01 % hr^{-1} as standard
- Large bore sizes from 77 mm to 150 mm diameter across the standard solenoid magnet range
- Typical ramping times of < 1 hour from 0 to rated field.

Magnet Options		Bottom Loader Puck Options	
Magnetic Field / T	Bore / mm	Puck Dia. / mm	Puck Connectivity
Up to 14	Up to 90	Up to 72	up to 28 coax, 96 DC

Vector rotate magnets

- Three axis vector magnets with a vertical field up to 9 T and a horizontal field up to 3 T
- Driven magnets as a standard with no persistent switch
- Typical ramp rates of 0.25 T/min
- 90 mm large bore across all field vector rotate options
- Typical tilt at 2.5 degrees for the maximum field axis e.g. 6-2-1 gives 6 T vector modulus, full rotation about the Y axis
- Full spherical rotation at the lowest rated axis e.g. 6-2-1 gives 1 T vector modulus, full rotation in a sphere about any axis or combination.

Magnet Options		Bottom Loader Puck Options	
Magnetic Field / T	Bore / mm	Puck Dia. / mm	Puck Connectivity
Up to 9,1,1	90	72	28 coax, 96 DC

Customised Magnets

Beyond standard offering, our in-house team can design bespoke magnets to meet your experimental needs. Full FEA and electromagnet modelling capabilities ensure the integration of the magnet to the system is robust in terms of both magnet and system performance.

Optimised for:

- Higher persistence
- Split pair configurations for optical access
- Custom vector combinations including optical vector magnets and persistent vector magnets
- Higher homogeneity over standard volumes or custom sample volumes with defined homogeneities
- Higher resolution
- Stray field reductions using active shield technology
- Gradient coils
- Field cancellation to < 0.01 T at the mixing chamber plate for sensitive equipment.

Options available to enhance the utility of your system with customisable features for specific applications.

Sample pucks for rapid exchange

Our patented, market leading sample loading mechanism allows for fast and easy sample exchange, without the need to warm the entire system to room temperature:

- *Loading a sample puck takes less than 15 minutes and the system automatically cools back to base temperature*
- *Up to 28 RF and 96 DC connections on a single sample puck*
- *Ideal solution for multi-user facilities since different experiments can be prepared in multiple sample pucks*
- *Patented loading concept allows for safe and easy operation.*

SampleProtect system secures against ESD

SampleProtect enables grounding or bias of samples during sample exchange to safeguard your experiments. It provides users with a method of protecting sensitive samples from accidental electrostatic discharge (ESD).

High quality, fully earthed cables for low level signals:

- *Low noise*
- *High attenuation shielding*
- *Low cross-talk.*

BNC or Twinax option.

24 connectors and 12 twisted pairs.

Service Support Options

Live Assist

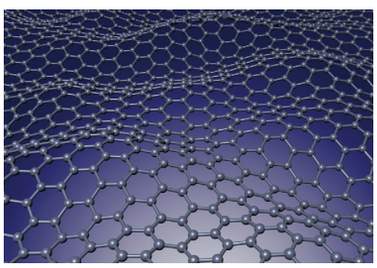
Live assist remote support empowers your technical staff to resolve issues fast and effectively. Our team of service and engineering professionals use the latest virtual reality tools to support you remotely.

Customer Support Packages

At Quantum Design Oxford, our customers' success is what matters most. Delivering maximum performance, our range of support packages enable our customers to maximise uptime and minimise cost, spreading cost of ownership into a simplified yearly fee. Our support packages can save up to 30% on maintenance costs compared to pay as you go service.

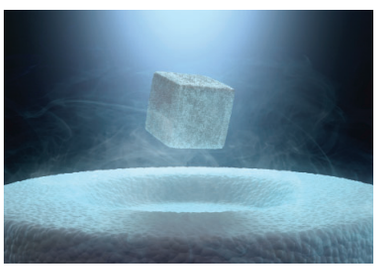
Quantum Technologies

- Quantum Sensing and Metrology
- Quantum Transport Measurement
- Quantum Computing
- Qubit Development.



Low Dimensional Materials

- Topological Insulators
- Graphene and 2D Materials
- Quantum Dots
- Nanowires.



Condensed Matter Research

- Bulk Magnetism
- Superconductivity
- Neutron Scattering
- Fermiology.

Probing and Sensing

- Flux Vortices
- SPM, STM, AFM
- Low Temperature Detectors
- Spintronics.

Quantum Design
OXFORD

Quantum Design Oxford
Tubney Woods, Abingdon
Oxfordshire, OX13 5QX
United Kingdom

www.qd-oxford.com
info@qd-oxford.com

+44 1865 393200