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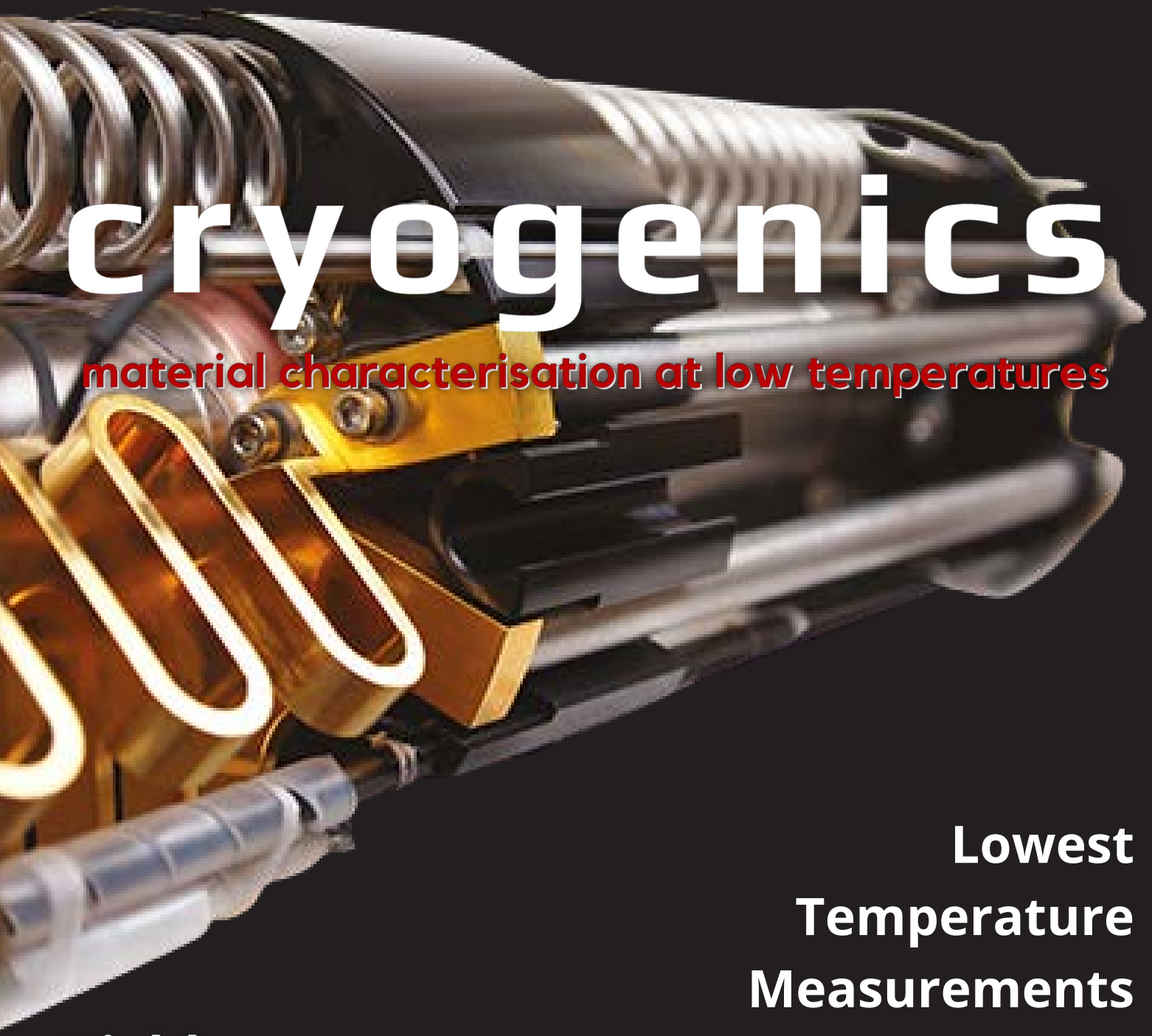

cryogenics

material characterisation at low temperatures

Lowest Temperature Measurements

Highly Customisable Cryostats

Case Study: Planar Hall Effect Investigation in Cryogenic Environment

Announcing the Next Generation of Helium Recovery!

Quantum Design
UK AND IRELAND

WWW.QD-UKI.CO.UK/CRYOGENICS

WITH CONTENT
CONTRIBUTIONS FROM
OUR PARTNERS:

Lake Shore Cryotronics
Leading researchers around the world trust Lake Shore for measurement and control solutions that drive the discovery and development of new materials for tomorrow's technologies. In electronics, clean energy, nanotechnology, and many other applications, Lake Shore provides the products and systems needed for precise measurements over a broad range of temperature and magnetic field conditions. Serving the needs of the research community since 1968 Lake Shore has grown its product solutions to keep pace with evolving interests in scientific exploration, from the physics lab to deep space. Through our international technical service and sales teams, we foster a culture of collaboration and innovation, and a commitment to the pursuit of science.

Montana Instruments
Montana Instruments® Corporation designs and manufactures high-precision electrical, optical, and cryogenic systems for quantum materials research and the quantum computing, sensing, and networking industries. Our solutions are focused on increasing productivity by re-defining automation, precision, and environmental control of wide temperature experimental platforms.

Quantum Design USA
Since its inception in 1982, Quantum Design International (a privately held corporation) has developed and manufactured automated temperature and magnetic field testing platforms for materials characterization. These systems offer a variety of measurement capabilities and are in widespread use in the fields of physics, chemistry, biotechnology, materials science, nanotechnology, and quantum information research.

Quantum Design
UK AND IRELAND

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CRYO WEBINARS

FOREWORD

Quantum Design UK and Ireland (QDUKI) is proud to bring you this newsletter with information about new products, publications and white papers that have been produced using products that we offer.

With the recent addition of Janis Research products through our partners, Lake Shore Cryotronics, we have strengthened our Cryogenics offering.

QDUKI is particularly proud of our involvement with the international effort (spearheaded by our parent company Quantum Design USA) to conserve helium. As well as promoting sustainability and awareness amongst the scientific community, we have launched a new generation of helium recovery systems.

QDUKI has been involved with Cryogenics now for 12 years both as a manufacturer and a distributor of low temperature instrumentation such as the PPMS and MPM3 and have continually added to supplying materials characterisation products from other leading vendors.

We firmly believe we have the best combination of instrumentation in cryogenics for investigation of new materials and for the optical Quantum computing QUBIT Technology revolution which hopes to replace the current mature but slow electronics era.

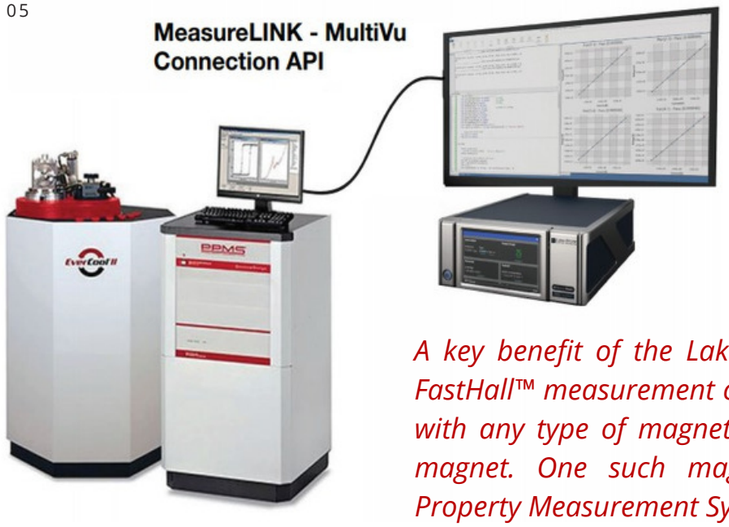
Dr. S Ikram

TECHNICAL DIRECTOR
QUANTUM DESIGN UK AND IRELAND

Advancing Materials Characterisation

Quantum Design
UK AND IRELAND

Lake Shore
CRYOTRONICS



discover the PPMS

discover the M91

A key benefit of the Lake Shore MeasureReady™ M91 FastHall™ measurement controller is that it can be used with any type of magnet, including a superconducting magnet. One such magnet system is the Physical Property Measurement System (PPMS®)

Did you know...

You can use a Lake Shore M91 FastHall measurement controller with a PPMS?

In 2019, Lake Shore Cryotronics introduced the MeasureReady™ M91 FastHall™ measurement controller. This single instrument combines voltage and current sources as well as measurements and switching elements with complete Hall calculations to provide a start-to-finish Hall analysis directly from the instrument. In addition, the M91 provides truly unique and patented new FastHall technology, which results in two important improvements:

- It enables the measurement of sample mobilities down to 0.001 cm2 /V s
- It eliminates the need to complete a physical field reversal during the Hall measurement

While the M91 can be integrated with any type of magnet system, it is very useful when used in conjunction with a superconducting magnet. This application note describes how the M91 FastHall measurement controller can be integrated into a measurement application using the popular Physical Property Measurement System (PPMS®) from Quantum Design.

The PPMS is a complete measurement system consisting of a low-temperature cryostat, superconducting magnet, and control electronics for making characterisation measurements. The system has a 12-pin sample puck, which is wired through a LEMO connector on the side of the cryostat. During general operation, the sample connector is connected to the PPMS electronics and the system's MultiVu™ software controls the field and temperature of the sample space while coordinating the measurement electronics contained in the PPMS system.

ADVANCING SCIENCE

Lake Shore CRYOTRONICS

JANIS

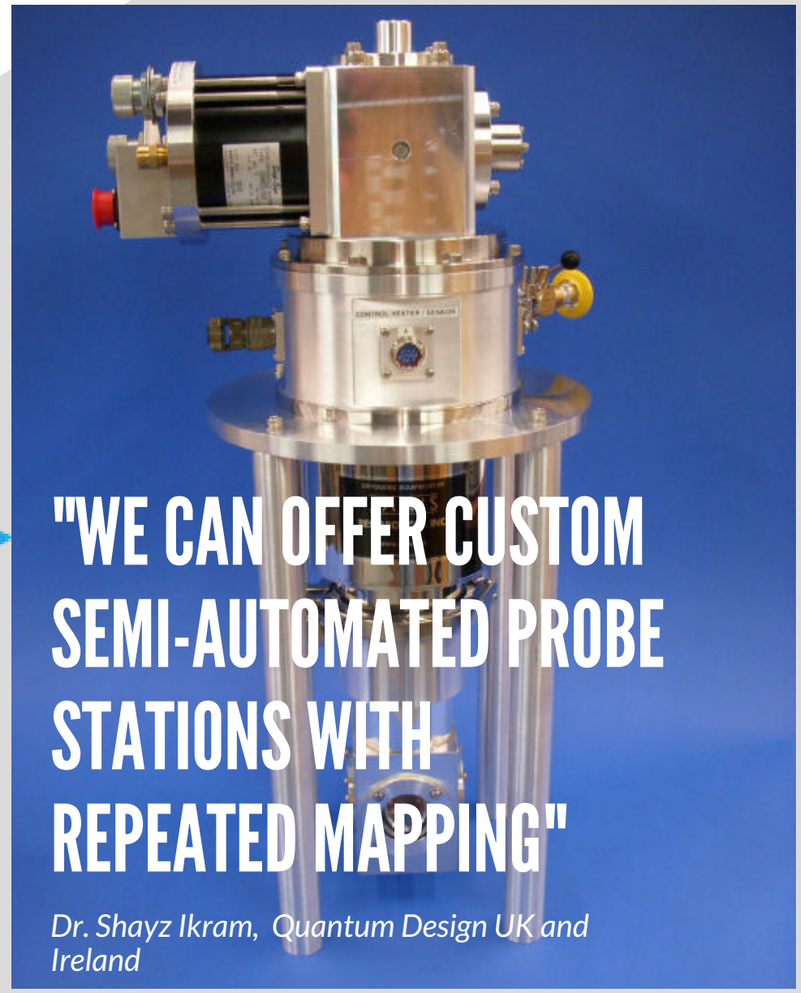
CUSTOM ENGINEERED CRYOGENIC SYSTEMS

In addition to their complete line of laboratory cryogenic equipment, Janis Research offers a wide range of award-winning custom system design capabilities. With in-house computing facilities, computerised designs and manufacturing capabilities, Janis' experienced physicists and engineers are readily available to discuss your special requirements for any type of cryogenic application

DESIGN CAPABILITIES

Typical examples of custom-engineered projects include:

- Cryogenic cold traps with single or multiple chambers for adsorption of noble gases, oxygen, nitrogen, carbon dioxide, water vapour, etc.
- Ruggedised cryostats designed for space flights/micro-gravity experiments and balloon-borne cosmic microwave studies
- Focal plane array and detector cooling Dewars for operation in any orientation
- Ultra-high vacuum cryostats and superconducting magnet systems for scanning probe, atomic force, and scanning tunnelling microscopes
- Cryostats that operate from liquid helium temperatures to high temperatures (750 K or higher)
- Custom vibration isolated systems
- Tensile testing and high-pressure diamond anvil cell cryostats
- Dewars designed to ASME code, with complete structural, stress, and thermal analysis



"WE CAN OFFER CUSTOM SEMI-AUTOMATED PROBE STATIONS WITH REPEATED MAPPING"

Dr. Shayz Ikram, Quantum Design UK and Ireland

Janis Research has the track record to back up its claim as the leader in custom cryogenics. Read on to find out about their two NASA Public Service Group Achievement Awards and our R&D 100 Award.

The combination of these awards clearly states, in a manner no publicity rhetoric can, that Janis has the capability, the track record, and the will to go beyond the commonplace and provide what others cannot.

What about your requirements? Aren't research and standard products contradictory? Your project is special and special equipment is often required.

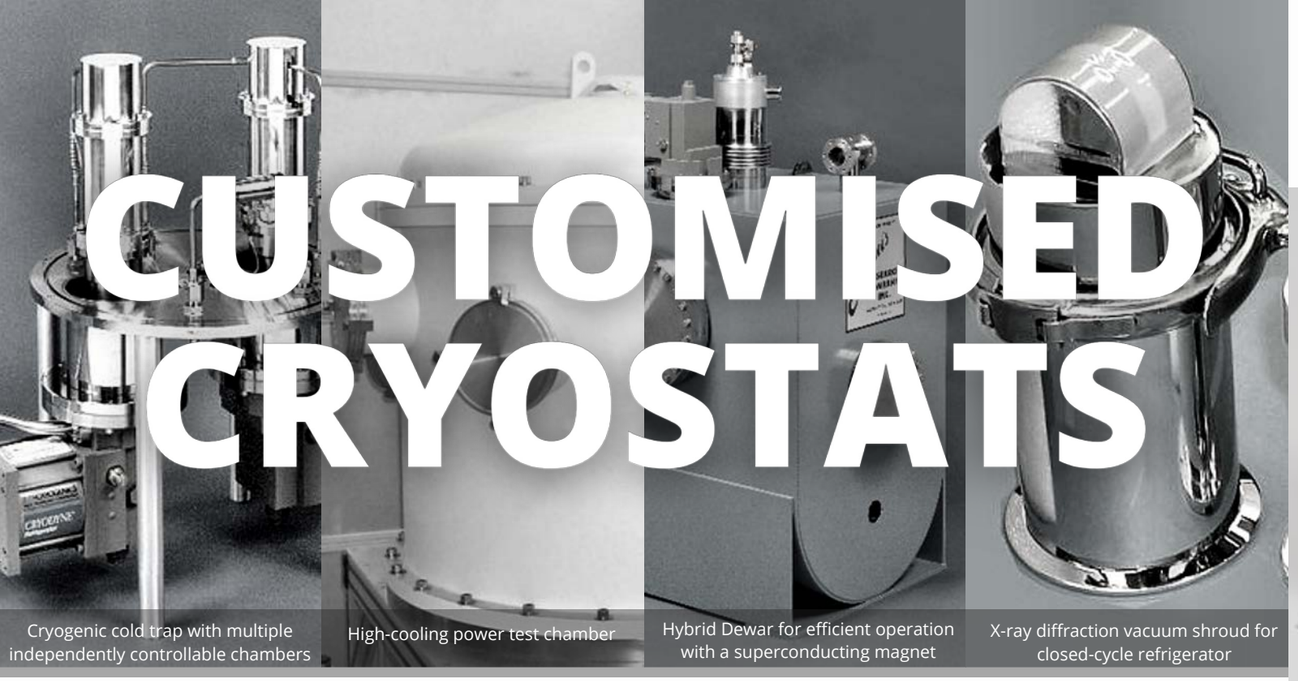
The Janis Research staff has the experience and the knowledge to help even the most challenging program.

Contact us here at Quantum Design UK and Ireland to discuss your particular custom cryogenic problem.

As a worldwide leader in laboratory cryogenics, Janis has developed many custom cryogenic configurations. Many of these have been refined into a standard product line and are available from inventory.

JANIS RESEARCH

CUSTOMISED CRYOSTATS



Cryogenic cold trap with multiple independently controllable chambers

High-cooling power test chamber

Hybrid Dewar for efficient operation with a superconducting magnet

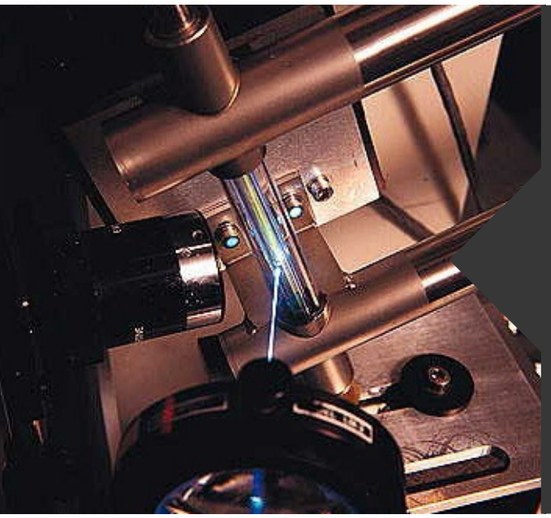
X-ray diffraction vacuum shroud for closed-cycle refrigerator

Products for exo-atmospheric research and astronomy

Janis Research has cooperated with NASA on several programs. The ARC Argus program, the successor to the ATLAS program, investigated the upper atmosphere from a balloon platform.

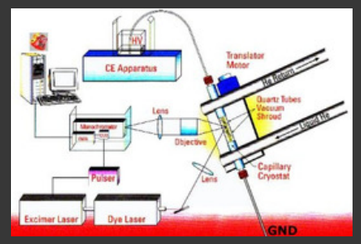
Of interest to the program was the tracking of inert tracer molecules for determining direction and speed. The Jet Propulsion Laboratory, in cooperation with Janis, produced the first viable test hardware on the SIRTF program. This project involved a mirror test and qualification operating at liquid helium temperatures.

NASA GSFC worked with Janis on the AImS camera testing requirements. Working with UMD and the GSFC Planetary Systems group, Janis developed a test enclosure to mimic the Mars environment for earth-bound terrain testing.



Capillary cooling cryostat

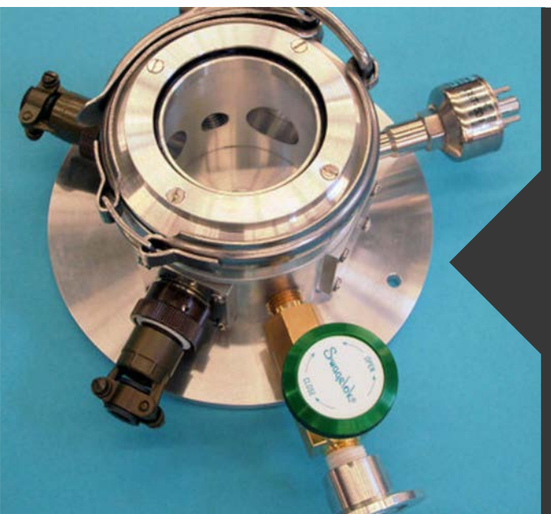
In 1998, Janis was awarded an R&D 100 Award for the development of a capillary cooling cryostat, allowing the disciplines of FLNS and capillary electrophoresis to be combined for the first time.



R&D 100

Solid neon shielded superfluid helium cryostat for micro-gravity studies in the space shuttle environment

In 2000, Janis received its second NASA Public Service Group Achievement Award, again from the Jet Propulsion Laboratory. This time it was for Janis' performance on the FACET program, the development of a cryostat to comply with the Shuttle Hitchhiker program, and providing a platform for microgravity experimentation. This second PSGAA, for a small company, is without precedent in the history of the JPL program and perhaps in all of NASA.



Room-temperature vacuum chamber

Shown is a room-temperature vacuum chamber made from a CCS-150 instrumentation skirt. It has an anti-reflection coated window installed on top, two ten-pin feedthroughs, and a thermocouple vacuum gauge. This can be used to make electrical and optical measurements under a vacuum at room temperature.

Cryostats for low-temperature system for atomic force microscopy (AFM)/scanning tunneling microscopy (STM)

A special helium Dewar was supplied to Seoul National University in South Korea. This unit was to be integrated into a UHV surface analysis system which includes instruments such as an AFM/STM probe. Featuring a modular design, this cryostat required the full complement of Janis' design and manufacturing capabilities—all at a cost far below our competitors.

ST500 PROBE STATION

JANIS

Variable temperature cryostat

The Janis ST-500 series probe stations are high-performance research instruments designed to provide affordable vacuum and cryogenic probing of wafers and devices. The proven ST-500 cryostat is the platform for these probe stations and includes low vibration technology (originally designed for high spatial resolution optical microscopy) to provide outstanding sample positional stability.

Looking for a cryogen-free option for your existing “wet” probe station? Optional recirculating gas cooler eliminates the use of liquid helium for “wet” systems.

Researchers around the world are using these systems to conduct research in a wide variety of fields, including MEMS, nanoscale electronics, superconductivity, ferroelectrics, material sciences, and optics.

- Low vibration level and the positional drift
- Temperature range from ~3.5 K to 475 K (optional: 8 K to 650 K) (depending on probes)
- Works either with liquid nitrogen or liquid helium
- Helium consumption less than 1 L/h
- Accommodates up to 2 in (51 mm) diameter wafers (optional: up to 8 in [203 mm])
- Up to seven cooled, easily interchangeable, micro-manipulated probe arms
- Electrical measurements from DC to 67 GHz
- Wide variety of inexpensive LF probe tips that are easy to replace
- Very low triaxial probe arms leakage current of just a few fA
- Non-contact, non-destructive Kelvin probes
- Multi-tip probes
- Fibre probe arms with single and multi-mode fibre options
- Optional optical access through the sample mount for transmission measurements
- Additional electrical feedthroughs with cables and wires to sample area
- Optional special miniature vacuum chamber to transfer sample under vacuum from glove box to probe station
- Very smooth x-y-z travel stages for all monoscope system assemblies
- Optional movable sample holder
- System customisation options

» discover the ST500

NEVER MISS ANOTHER UPDATE

join our newsletter

Here at Quantum Design UK and Ireland, we only want to send you the information that you would like to see. When filling out the form, please tick the particular fields and product suppliers that interest you, and we will make sure you are kept up to date with ONLY the most relevant information.

THE QUANTUM DESIGN RANGE

Quantum Design

Quantum Design (QD) is the leading commercial source for automated materials characterisation systems incorporating superconducting technology.

These systems offer a variety of measurement capabilities and are in widespread use in the fields of physics, chemistry, biotechnology, materials science and nanotechnology.

QD instruments may be found in the world's leading research institutions, and have become the reference standard for a variety of magnetic and physical property measurements. Quantum Design, Inc. instruments are cited in, and provide the data for, more scientific publications than any other instrument in the fields of magnetics and materials characterisation. This means that each year, literally hundreds of scientific publications, advancing the science of materials, use data generated from QD instruments.

Range:

- QD Tuneable Light Source
- QD Material Characterisation Range
- QD OptiCool Cryostat
- QD Helium Liquefiers

Contact us here at Quantum Design UK and Ireland to discuss your requirements

Quantum Design VersaLab™ Measurement System

3 Tesla Cryogen-free Physical Property Measurement System

Utilising a new approach to cryocooler equipment design, VersaLab employs a new 4He-based temperature control system and gas flow technology that eliminates the need for liquid cryogens.

With a temperature range of 50 – 400 K, this 3 Tesla platform is perfect for accomplishing many types of materials characterisation in a limited space. As with all Quantum Design instruments, VersaLab is a fully automated turnkey system with a user-friendly interface, and utilises technology developed for Quantum Design's popular Physical Property Measurement System (PPMS®).

Technical Service and Application Support is available for the Quantum Design VersaLab

VersaLab is specifically designed for material characterisation up to 3 Tesla and over a wide temperature range without the need of liquid cryogens.

discover the VersaLab

Researchers in the Department of Physics at University of York are looking forward to working with the Quantum Design Versalab system

Dr Stuart Cavill, Deputy Co-ordinator of the Condensed Matter Research Group at the University of York comments that...

"The system expands our suite of instrumentation, adding a new low temperature physics research capability. We found the QDUKI Sales and Service team very responsive and everything has been dealt with very efficiently and professionally."

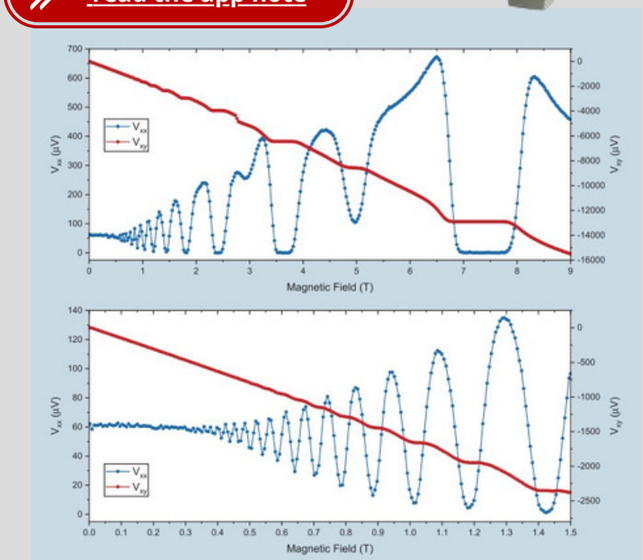
QD have supported Materials Characterisation systems for more than 35 years and are a leading manufacturer in this field.

Quantum Design VersaLab™ Measurement System

Applications

Van der Pauw

read the app note



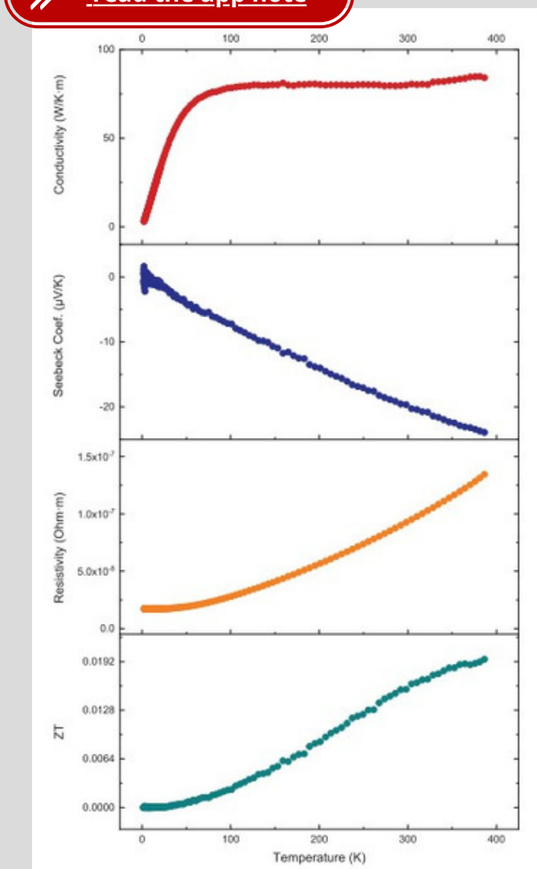
Field-dependent longitudinal and transverse voltage signals measured for a GaAs 2-D electron gas system at 1.7 K with 1 μA sourced DC excitation current in the van der Pauw geometry. In the upper frame, plateaux demonstrating the integer quantum Hall effect correspond to where the Fermi level falls in an area of localized states between neighbouring Landau levels.

The lower frame depicts the same parameters, collected at a slower field ramp, allowing the Shubnikov-de Haas oscillations to be resolved in regions of comparatively lower magnetic field strength.

Sample provided by M. Pendharkar, Chris Palmstrøm Group, University of California Santa Barbara

Thermal Transport Option

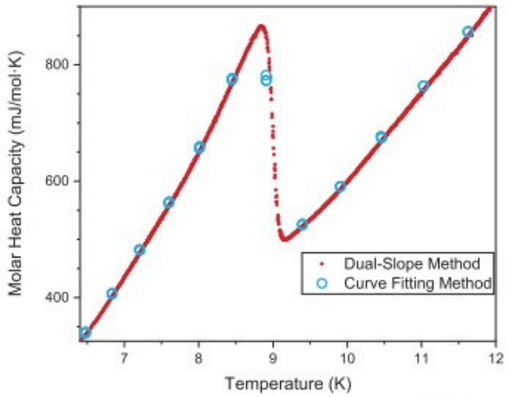
read the app note



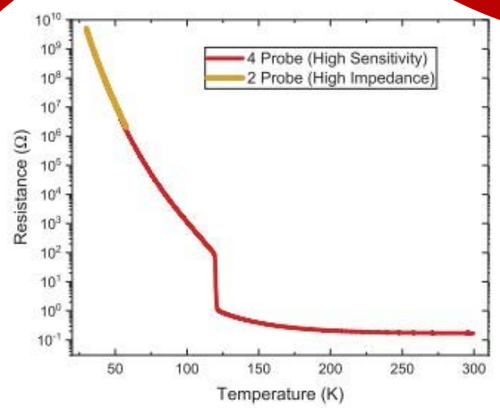
A typical response of the three properties measured by the TTO (thermal conductivity, Seebeck coefficient, electrical resistivity) are all shown, along with the calculated thermoelectric figure of merit ZT, for the nickel reference sample included with the option.

Heat Capacity Sample Mounting Station

read the app note



A superconducting transition is shown for a sample of NbTi alloy near 9 K. The open blue circles indicate data collected using the default curve fitting technique on a number of small heat pulses while the smaller closed red points were acquired using the slope-fitting analysis of a single large heat pulse.



Temperature dependence of the resistance of a magnetite (Fe_3O_4) mineral sample. The high-resistance data is collected using the 2-probe (high impedance) mode, while the rest of the range is covered by the more conventional 4-probe configuration for increased sensitivity. Note that the Verwey transition can be resolved near 120 K..

read the app note

Electrical Transport Head

Contact us here at Quantum Design UK and Ireland to discuss your applications.

Useful Links for QD Systems

PHAROS Digital Library
QuantumDesign

Pharos is an online repository of > 1,000 files related to the use of all Quantum Design measurement systems, measurement options, and other distributed products

Applications Team Notes and Downloads

Parts and Consumables

The UK Service Department offers fast front line local support to users within the UK and Ireland. We are backed by our extensive and experienced European Service Department, based in Darmstadt Germany, and by our US Service Department and Factory Engineers, based in the Quantum Design Headquarters in San Diego, California. We offer helpful advice and can work with you to find individual solutions to your particular application.

Already a customer? Please use the service email for any service issues service@qd-uki.co.uk

WATCH CRYO WEBINARS

Don't miss out on the best webinars in the field of Cryogenics

1

COLOUR CENTRES FOR QUANTUM INFORMATION PROCESSING

BY MONTANA INSTRUMENTS, WITH PHYSICS WORLD TODAY

Practical Experimental Considerations for Characterising and Tuning Quantum Emitters Using a High-NA, Low Vibration Cryogenic Environment.

watch now

2

VIRTUAL TOUR THROUGH QDE'S APPLICATION LABORATORIES

BY QUANTUM DESIGN EUROPE

Glance behind the scenes to see real cryogenic and magnetic measurements

watch now

3

CRYOGENIC PROBING PLATFORMS

BY LAKE SHORE CRYOTRONICS

Materials and Device Development - including discuss key applications, including wafer-level Hall effect, transistor characterisation, Raman studies, ferroelectric material and device measurements, and wafer-level microwave characterisation.

watch now

4

BROADBAND FERROMAGNETIC RESONANCE: CRYOFMR

BY QUANTUM DESIGN USA

A webinar from Quantum Design featuring the NanOsc CryoFMR FMR Spectrometer

watch now

5

THERMAL TRANSPORT OPTION

BY QUANTUM DESIGN USA

Learn more about our Thermal Transport option for the PPMS, DynaCool, and VersaLab platforms. Including: Measurement theory, hardware overview, measurement procedure (sample mounting, sequence writing), data quality evaluation, maintenance.

watch now

6

PROBING MAGNETODYNAMICS AT NANOSECOND TIMESCALES AND BEYOND

BY QUANUM DESIGN EUROPE

Quantum Design's latest efforts to enable high frequency magnetodynamic measurements of both fundamentally interesting and technologically relevant materials at ultra-short timescales.

watch now

7

CRYOGENIC SENSORS: INSTALLATION TECHNIQUES FOR SUCCESS

BY LAKE SHORE CRYOTRONICS

Interested in knowing more about how to correctly install a sensor in a cryogenic application and to avoid common installation errors? Then watch this recording of an Institute of Physics (IOP) webinar presented by Dr. Scott Courts, Lake Shore Senior Scientist.

watch now

Focus On:
TEMPERATURE SENSORS

240 Series Input Module

SIMPLIFYING LARGE-SCALE CRYOGENIC TEMPERATURE MEASUREMENT

The new 240 Series offers a convenient, modular input solution for precision monitoring of cryogenic temperature sensors in large-scale applications employing distributed PLC-based control.

Lake Shore benchtop cryogenic instruments are trusted throughout the world for precision temperature measurement—now that same measurement performance can be achieved in widely distributed high energy applications like particle accelerators and fusion reactors as well as other large industrial sites.

learn more

FEATURES

Integrates seamlessly with industry-leading Lake Shore Cernox® RTDs, platinum RTDs and DT 670 silicon diodes, providing the ideal solution for performing temperature measurements over a PLC network

Normal mode with EMF-cancellation and signal filtering for the best measurement possible or high-speed mode for the fastest notification of a temperature change

Native support for PROFIBUS, allowing this module to be integrated into a wide range of PLC networks

A high-quality OLED display on the front of the unit provides helpful status and measurement data; this is in addition to being able to access this information via the PLC network or the local USB connection

Temperature values are communicated directly with the PLC master device, removing the need to use additional costly analog conversion equipment or complex PLC programming to generate temperature values

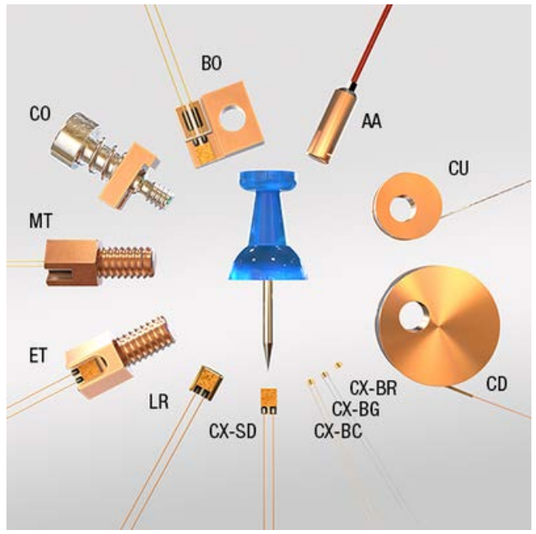
Convenient pluggable connectors allow individual sensors to be disconnected for maintenance without losing readings from other sensors on the same module

Measurement circuitry based on Lake Shore's industry leading benchtop instruments, allowing for longer cable runs between sensor and module; ideal for applications where sensors must be located in hazardous environments

Easy DIN rail mounting with integrated rear connections allowing power and fieldbus communications to be shared between modules

Cernox®

The smaller package size of these thin film sensors makes them useful in a broader range of experimental mounting schemes, and they are also available in a chip form.



Cernox™ Resistance Temperature Sensors for High Energy Physics Applications

TEMPERATURE SENSORS FOR HIGH ENERGY PHYSICS APPLICATIONS

Cernox® thin film resistance cryogenic temperature sensors offer significant advantages over comparable bulk or thick film resistance sensors

The cryogenic temperature sensing requirements of superconducting magnets used in high energy physics accelerators present a unique challenge. The sensors must operate at cryogenic temperatures below 4.2 K with low magnetic field-induced calibration offsets at fields ranging to 10 T. They must provide high resolution with fast response times to detect potential superconducting magnet quenches. The sensors must be stable over time and thermal cycling with low radiation-induced calibration offsets up the anticipated accumulated dose over the lifetime of the accelerator.

This combination of unique requirements severely limits temperature sensor choices for monitoring superconducting magnets. Cernox™ resistance temperature sensors, manufactured by Lake Shore Cryotronics, Inc., were specifically designed and developed for the purpose of monitoring superconducting magnets used in high energy accelerator facilities and meet the criteria required for this application. This work details performance specifications for Cernox resistance temperature sensors with regard to their suitability for high energy physics applications.

Read the full white paper

MONTANA INSTRUMENTS®
COLD SCIENCE MADE SIMPLE

C2 CRYOSTATION

"We use our C2 Cryostation to maintain our thin semiconductor samples at 4 K while we make measurements with a high power pulsed laser. Our data acquisition patterns require us to maintain these conditions for days or weeks at a time with minimal interruption.

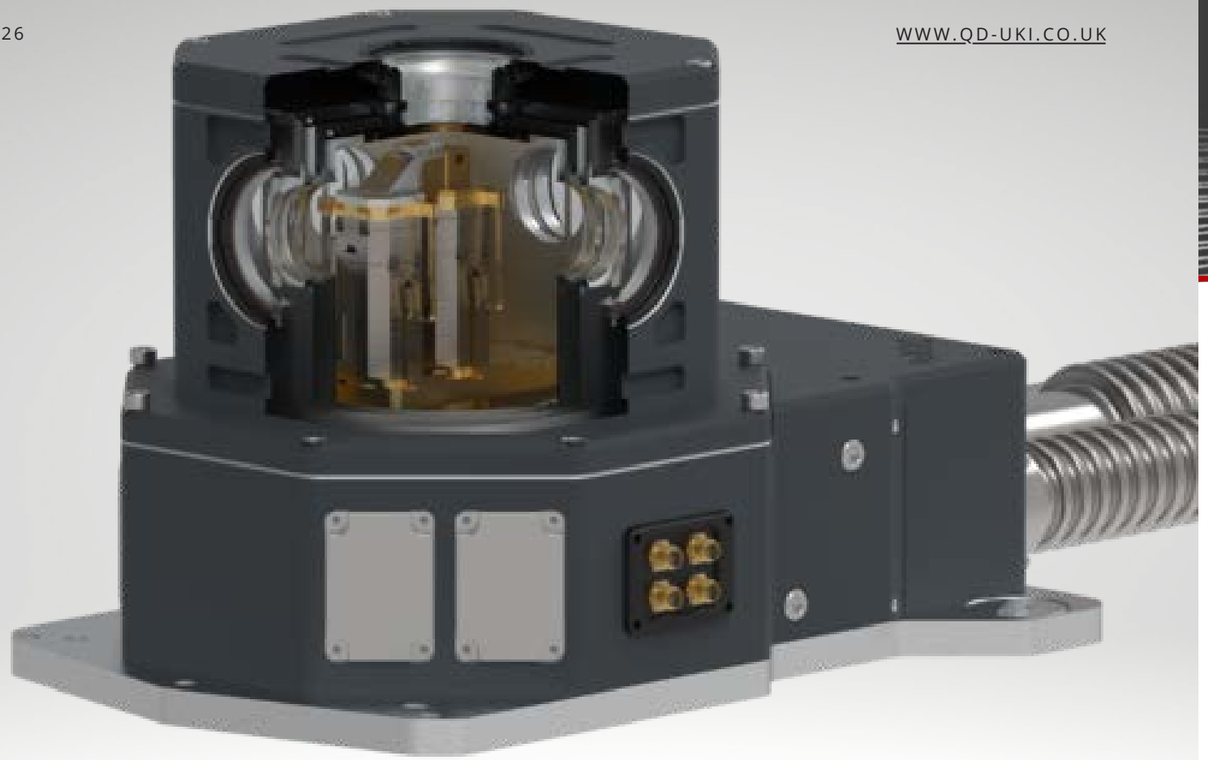
We have found the Cryostation to be an extremely low-maintenance system that has placed negligible demands on our time and budget to operate continuously for over 2 years and counting. We observe good stability in both temperature and mechanical performance.

We have also received excellent post-sale support. QD UKI provided a full technical training and installation service and Montana have been happy to provide design information that has enabled us to fabricate bespoke accessories and integrate the instrument more closely into our wider experimental system.

Overall, the Cryostation's most **appealing characteristic** is how easy and convenient it has proved to be, enabling us to focus on the aspects of our research project that deserve the most attention."

DR JOSHUA ROGERS
DURHAM UNIVERSITY

View the C2 Cryostation



"**The Montana Cryostation** lies at the heart of a number of experiments in my group. The Cryo-Optic add-on allows us to perform optical spectroscopy on single organic molecules at low temperature with excellent collected photon count rates from the in-vacuum high-NA objective. The system reaches a base temperature low enough to observe atomically-narrow resonances in these molecules, making them suitable for use in quantum technology.

The automated temperature control allows us to investigate the effects of phonon-induced dephasing with ease, while the integrated nano-positioning system and sample holder – designed in collaboration with Montana Instruments and QD-UK – is fully compatible with the nanophotonic devices we are investigating at low temperature.

All of our experiments benefit from the low vibrations seen in the Montana Cryostation, from stable coupling to nanophotonic waveguides to diffraction-limited confocal microscopy. The support we have received from QD-UK has been excellent – they are easily contactable should issues arise and are very open to collaborative problem solving to expedite finding a solution.

Having all of this in a closed-cycle system that does not require the purchase of expensive and increasingly rare liquid helium is the icing on the cake."

Dr Alex S. Clark
Centre for Cold Matter
Imperial College London

View the C2 Cryostation

HELIUM CONSERVATION

Helium Conservation Day takes place on the anniversary of the ground-breaking work by Dutch physicist Heike Kamerlingh Onnes at the University of Leiden in the Netherlands which led to the first liquefaction of liquid helium.

10th July

"We need to be good stewards for earth's precious resources and we have developed methodologies and equipment that capture, recycle and reuse helium for our use and to help our customers.

Our product development has always focused on optimising the consumption of liquid helium and we will continue to do so.

Thank you for helping us recognise the need for conservation and recycling. Let's all go green for helium."

Greg DeGeller, President of Quantum Design

READ MORE >

physicsworld

"As well as floating balloons and making your voice sound funny, helium plays a crucial role in science and medicine – thanks to its cryogenic properties."

NexGen 250

ATP30

NexGen 160

INTRODUCING...

THE NEXT GENERATION OF HELIUM RECOVERY

Quantum Design Launches the NexGen & ATL Liquefiers and Purifiers

Quantum Design's liquefiers and helium recovery systems allow you to recycle the helium gas currently being lost from the normal boil off and helium transfers of your cryogenic instruments. An adaptable helium recycling solution for research and medical cryostats, these helium liquefiers and recovery systems allow you to always have access to a supply of liquid helium without being reliant on suppliers of cryogens or subject to unpredictable price changes.

"The small liquefiers are easy to use and can deliver 500-600 litres per week to satisfy our institution's needs."

Physics Department, Leiden University

Quantum Design's newest

helium recovery technology provides:

- 160 and 250 litre capacity dewars (for labs that prefer larger transfers)
- Improved liquefaction rates at 1 PSIg so helium is ready when you need it
- Newly-designed purifier that offers same industry-leading performance in a smaller size
- Optional variable speed compressors that provide energy efficiency and longer life of cold heads
- New simplified software with intuitive user interface for easier operation
- Wide range of custom recovery systems available for needs small and large, including direct recovery and recovery systems with medium and high-pressure storage

"We were most surprised by the high level of Helium recovery made possible by the ATL system."

Servicios Científico-Técnicos, University of Oviedo

Quantum Design
RECYCLING HELIUM

You can do your part to conserve a precious natural resource which is vital to scientific research and medical treatment.

View the Helium Recovery Range

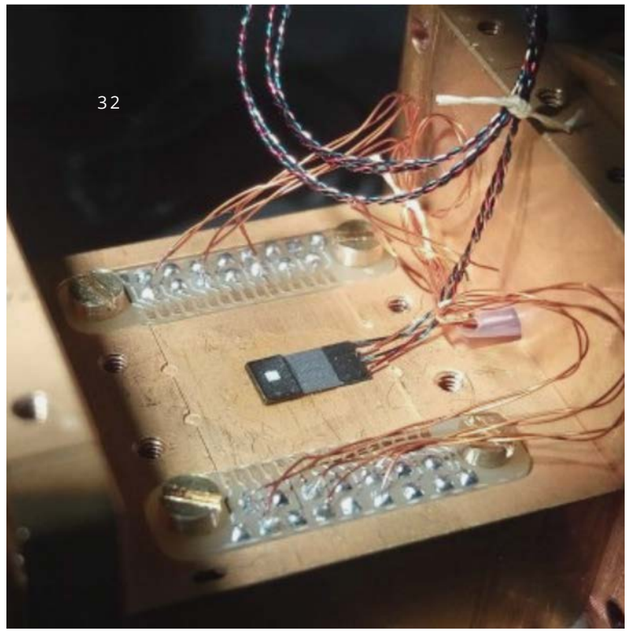
Liquid Helium Your Way

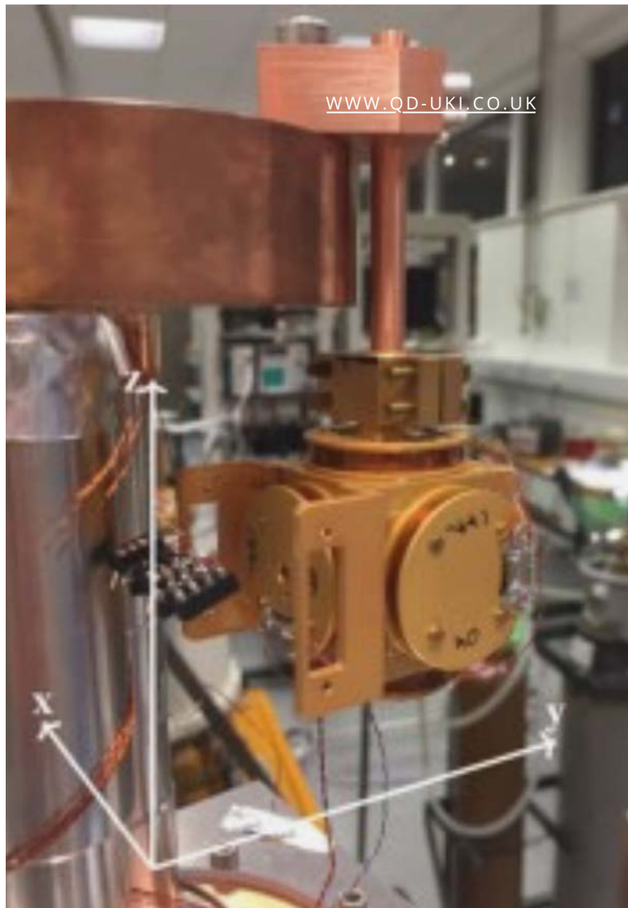
Whether you have a large laboratory or small, with many cryogen-using instruments or just one, Quantum Design has a helium recycling option perfectly suited for you. Helium Recycling Systems can be individually configured for a variety of laboratory sizes and types. All recycling systems have fully integrated components with most functions being automated or very easily operated.

Recycling systems can be used with a wide range of cryogenic instruments including NMR, MRI, MEG and other assorted cryostats. Custom fittings and connections are available for a wide range of instruments to allow for seamless integration into your laboratory or scanning center. Fail-safe protections are built into every stage of our recycling systems so that in the occurrence of an accident, the rest of the recycling system and your cryogenic instruments are protected from damage or contamination.

Break your dependence on cryogen suppliers and no longer be subject to higher costs and undependable supply

QUANTUM DESIGN





CASE STUDY

Planar Hall Effect Investigation in Cryogenic Environment

University of Cambridge – Quantum Sensors Group

Accurate magnetic field measurement is often a challenge in fundamental research scenarios, particularly when dealing with vector fields in cryogenic environments. Cryogenic conditions rule out many of the clever new monolithic/integrated 3-axis Hall probes that include signal conditioning circuitry in the sensor itself.

The case study included the Lake Shore HGCT-3020 cryogenic Hall sensor and the 2Dex plug-and-play Hall sensor (Lake Shore 2X-250-FT-1CBL-2 connected to F71 teslameter).

The Quantum Sensors Group at Cambridge University develops ultrasensitive superconducting detectors to detect radiation across the electromagnetic spectrum.

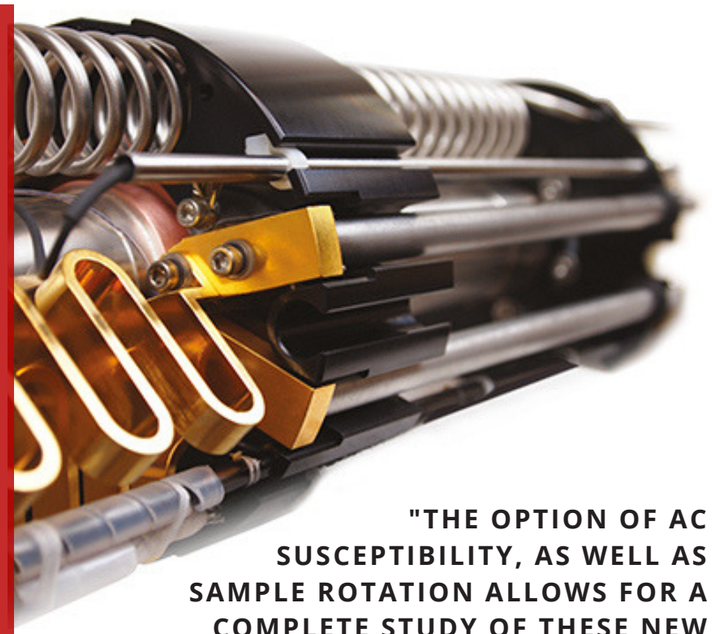
2Dex Hall sensors paired with a Lake Shore teslameter have been demonstrated to provide superior measurements when compared to previous generation gaussmeters and InAs Hall sensors. Measurement errors as a result of offset voltages and the planar Hall effect are eliminated, as well as seeing an improvement in measurement resolution

Read the full case study here

CASE STUDY

Squid Enables Highly Accurate Study of Magnetic Materials

HENRY ROYCE INSTITUTE



"THE OPTION OF AC SUSCEPTIBILITY, AS WELL AS SAMPLE ROTATION ALLOWS FOR A COMPLETE STUDY OF THESE NEW MAGNETIC MATERIALS."

Prof Nicola Morley

Superconducting Quantum Interference Device (SQUID) magnetometers are vital instruments in the study of magnetic materials. The high sensitivity of the equipment means that they allow for a much more accurate determination of magnetic properties on materials where the magnetism is extremely weak.

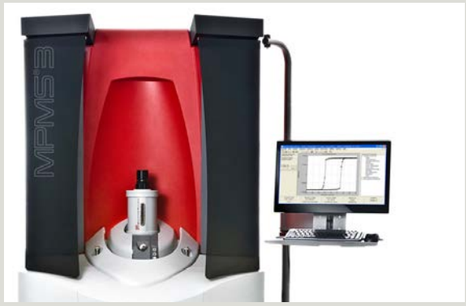
The Henry Royce Institute funded SQUID MPMS 3 is regularly being used by the University of Sheffield's Functional Magnetics Group, as well as the wider Sheffield research community. It has enabled the study of novel magnetic materials such as magnetocaloric (MCE) materials, whose characterisation requires their magnetisation to be measured over a wide temperature and magnetic field range.

The system has allowed them to study a range of these materials, as it has a wide temperature capability from 2.5K to 1000K and magnetic fields up to 7 T. For thin film research, the in-plane rotator has enabled us to study the in-plane anisotropy of new magnetic alloys.

Prof Nicola Morley, Professor of Materials Physics at the University of Sheffield, has been overseeing the Henry Royce Institute's MPMS 3 system and, along with her group, is using it to carry out world leading research on novel soft magnetic materials such as high entropy alloys. The research aims to discover new functional magnetic materials for applications, such as transformers, actuators and magnetic-refrigeration.

"The MPMS 3 system is an ideal system for material discovery research, as a high throughput of samples can be measured quickly and easily at room temperature, with those of interest being investigated further over a wide temperature and magnetic field range. "

Prof Nicola Morley, Professor of Materials Physics at the University of Sheffield



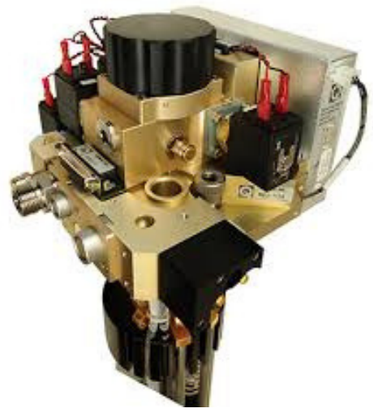
Quantum Design MPMS ®3

The Quantum Design MPMS 3 enables a greater range of magnetic and electrical measurements to be performed. As well as the study of novel materials such as magnetocaloric (MCE) materials, the MPMS 3 can be used to investigate superconductors, magnetic nanoparticles, 2D materials, 3D printed permanent magnets and inorganic magnetic oxides, as a function of temperature and magnetic field.

Quantum Materials Research

Dr Otto Mustonen, Postdoctoral Research Associate at the University of Sheffield, has been using the Henry Royce Institute's MPMS 3 to carry out research in the field of quantum materials, where quantum effects are strong and lead to novel properties and phenomena.

Materials with strong quantum magnetism can lead to very exotic magnetic states such as quantum spin liquids, and the resulting materials could potentially be used for quantum informatics applications, which in turn could form the building blocks of an entirely new type of quantum computer.



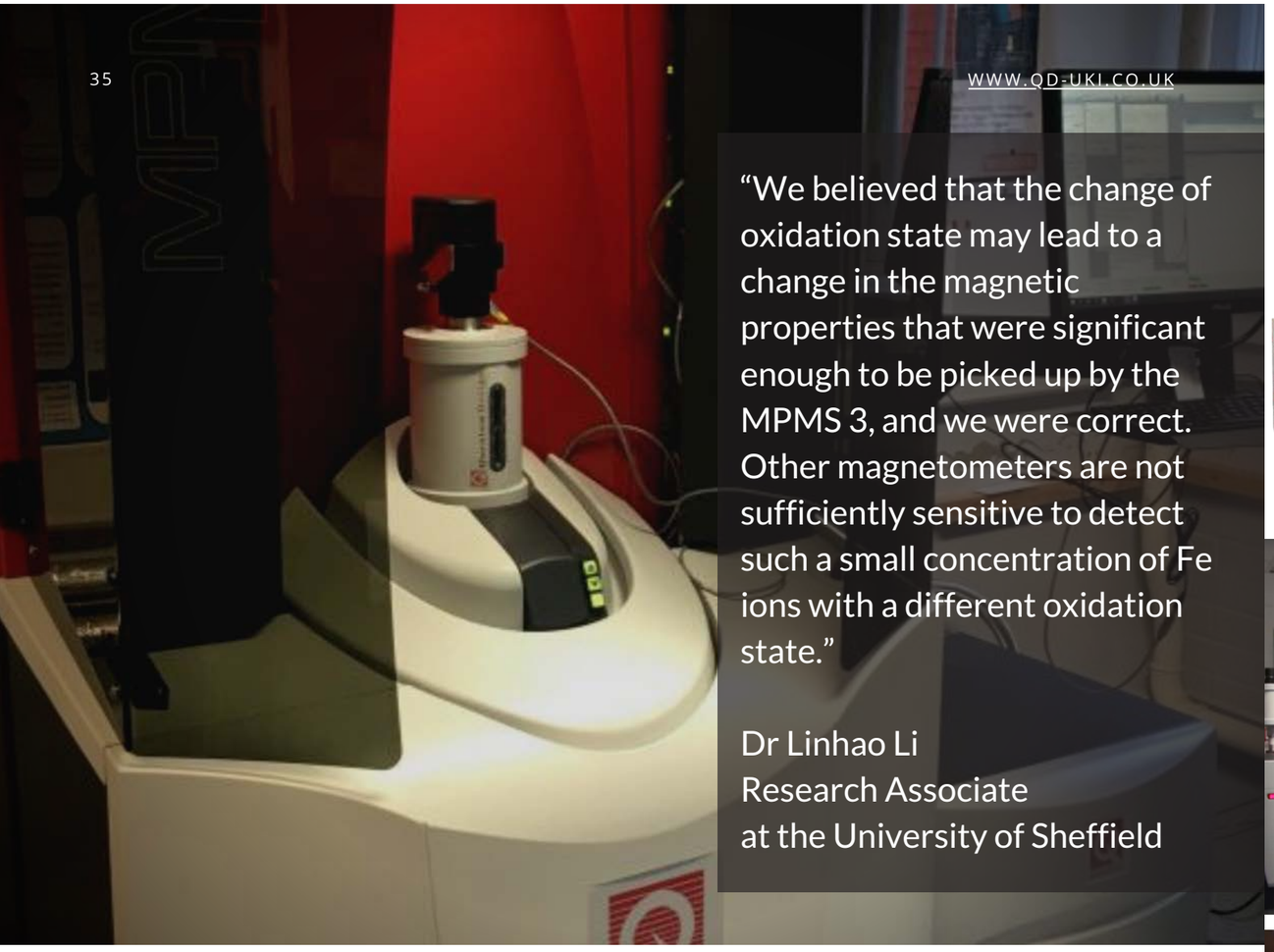
"The MPMS 3 is by far the best magnetometer on the market.

It is a sizeable upgrade on previous MPMS models and it allows quicker, more accurate measurements, while its cryogen-free operation slashes running cost to a mere fraction of the older systems. And it is generally much easier to use.

In my case, I often work on materials where the magnetism is extremely weak.

The MPMS 3 provides a much more accurate determination of the magnetic properties for these kind of materials."

Dr Otto Mustonen,
Postdoctoral Research Associate
at the University of Sheffield



"We believed that the change of oxidation state may lead to a change in the magnetic properties that were significant enough to be picked up by the MPMS 3, and we were correct. Other magnetometers are not sufficiently sensitive to detect such a small concentration of Fe ions with a different oxidation state."

Dr Linhao Li
Research Associate
at the University of Sheffield

Metal Oxides Research

Dr Linhao Li, Research Associate at the University of Sheffield, works predominantly on metal oxides, researching their electrical properties such as conduction mechanisms, dielectric properties and piezoelectric properties.

He has used the MPMS 3 to determine the change of oxidation state of Fe ion in doped Bismuth Ferrite ($BiFeO_3$) ceramics under different processing conditions. However, the concentration of Fe ions with changed oxidation state is relatively low and therefore hard to be verified by other techniques.

Impact

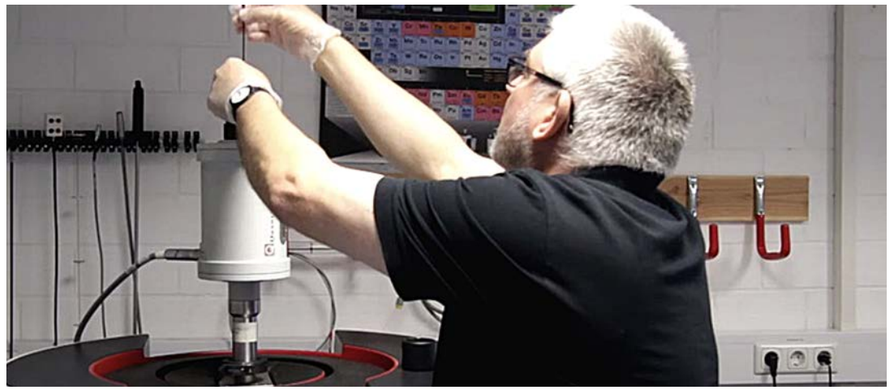
"Having access to the SQUID MPMS 3, which is the best magnetometer available, is enabling us to carry out far more advanced research in the area of magnetics.

The system has more than 15 trained users from the departments of Physics, Chemistry, Medicine and Materials Science, and we'll be able to continue to train more people to be able to investigate further the properties of novel functional materials."

Want to see your Case Study included in the next edition? Contact QDUKI today and we'd be happy to work with you to put it together..

VIBRATING SAMPLE MEASUREMENT

COOLING DOWN



Video by Quantum Design Europe

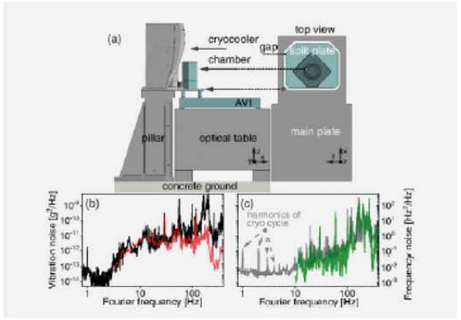
This video shows the simplicity of preparing and mounting a sample with the Quantum Design DynaCool with VSM option.

It shows how to use the VSM option of a PPMS-DynaCool – from sample mounting to sequence writing. You can spot the data points growing and the instrument cooling down to 2 K.

Play the video:

IN THE NEWS

MITIGATING THERMAL AND VIBRATIONAL NOISE WHITE PAPER



Many researchers employ low temperatures in their optical cavity experiments to reduce phonon broadening and enable material observations inaccessible at room temperature. For researchers studying optical cavities, there are experimental considerations that extend beyond simply achieving cryogenic temperatures. Factors such as temperature stability, ultra-low vibrations and accelerations, and the demands of sustaining a cryogenic environment for days, weeks, or even months deserve heightened importance when working at low temperatures.

Montana Instruments considers two experiments which were configured to perform cavity physics at cryogenic temperatures, and also discusses recent advances in closed-cycle technology which will reduce the barrier to entry of performing low temperature optical cavity experiments.

READ MORE >

LATEST RESEARCH WITH OPTICOOL

Professor Rick Averitt (UCSD Physics) and Jovan Nelson (Stern Group, Northwestern University) discuss their latest research using OptiCool, PLUS a recent publication: Magnetoelastic coupling to coherent acoustic phonon modes in the ferrimagnetic insulator GdTiO3

READ MORE >

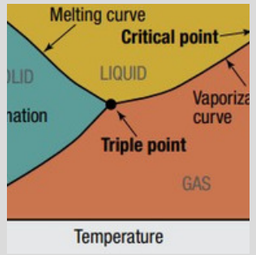
UNDERSTANDING & MINIMISING ERRORS THAT CAN INTERFERE WITH HALL EFFECT MEASUREMENTS

Hall effect measurements are a fundamental tool for semiconductor material characterisation. However, the challenge with some Hall voltage measurements is that they can be at low voltage levels, and at these levels, error terms can significantly impact the quality of the measurement. This new technical note addresses the most common of these errors and recommends methods to either eliminate or minimise such errors to achieve quality Hall effect measurements.

READ MORE >

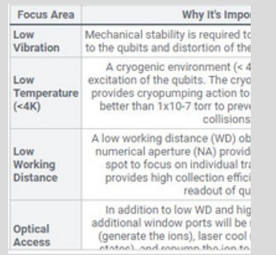
PUBLICATIONS

White papers, articles and App Notes



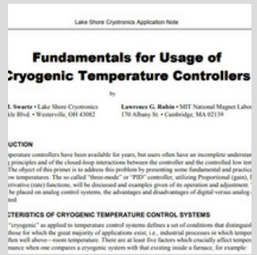
OVERVIEW OF THERMOMETRY

GENERAL THERMOMETRY AND TEMPERATURE SCALES



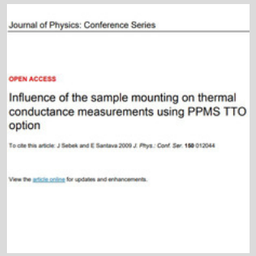
QUANTUM COMPUTING IN CRYOGENIC SYSTEMS

KEYS FOR OPTIMISING A QUANTUM COMPUTING EXPERIMENT



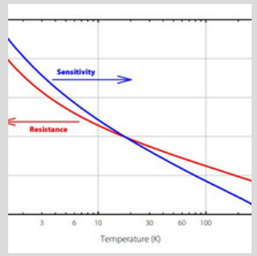
CRYOGENIC TEMPERATURE CONTROLLERS

FUNDAMENTALS FOR USAGE



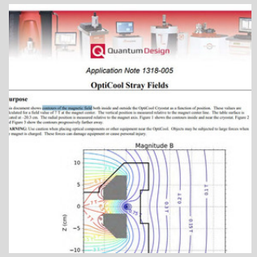
INFLUENCE OF THE SAMPLE MOUNTING

ON THERMAL CONDUCTANCE MEASUREMENTS USING PPMS TTO OPTION



IS HIGHER RESISTANCE BETTER?

NEGATIVE TEMPERATURE COEFFICIENT TEMPERATURE SENSORS



OPTICOOL STRAY FIELDS

CONTOURS OF THE MAGNETIC FIELD

HAVE YOUR SAY

BE INCLUDED IN THE NEXT EDITION

SEND IN YOUR RESEARCH OR WHITE PAPERS

We'd love to share your findings

SHARE YOUR APPLICATIONS

What have you been using systems for recently?

cryogenics

Further reading:

Material Characterisation

Cryogenics - Lake Shore

Cryogenics Range

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