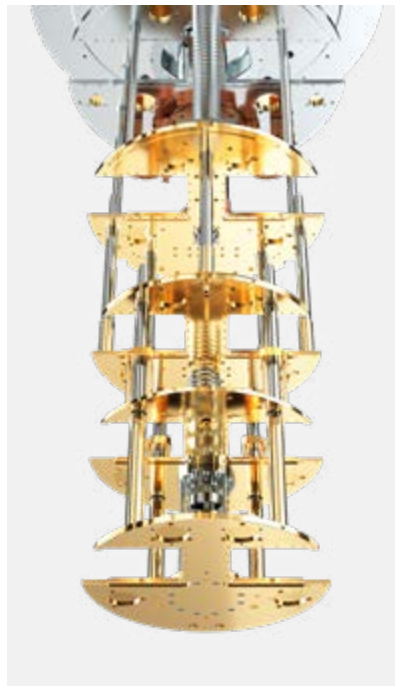


°BLUEFORS

Cool Quantum Solutions



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Introduction

Bluefors – A World of Cold

What happens when you make something cooler than anything else in the known universe?

You solve humanity's greatest challenges, and that's what we are all about. We have built Bluefors from an idea into a market leader to empower companies to solve fundamental questions and innovate at low temperatures. We operate in a world of cold, where laws are determined by quantum mechanics.

Our story began when we created our first prototype of a new dilution refrigerator, allowing physicists to reliably reach ultra-low temperatures for the first time. Since then, our constant search for perfection has led to Bluefors becoming the market standard for reliable cryogenic measurement systems, cryocoolers and inventive cryogenic products.

To put it simply - cool problem-solving is in our DNA.

At Bluefors, we are people from different cultures and backgrounds based all over the world and with a vast array of experiences. But we all speak the same language: Progress.

As physicists, we understand low-temperature conditions better than anyone. As engineers, curiosity

is at our core. And as like-minded professionals, we know that every obstacle requires its own unique solution. We take on the most difficult problems, so you can focus on your mission and reach your goals.

Enabling quantum computing is the key to unlocking human potential. Whether it's inventing the next life-saving medicines, enabling green energy production, or transporting humans most efficiently, progress happens in the quantum space. Working in a cool Bluefors environment makes that progress possible.

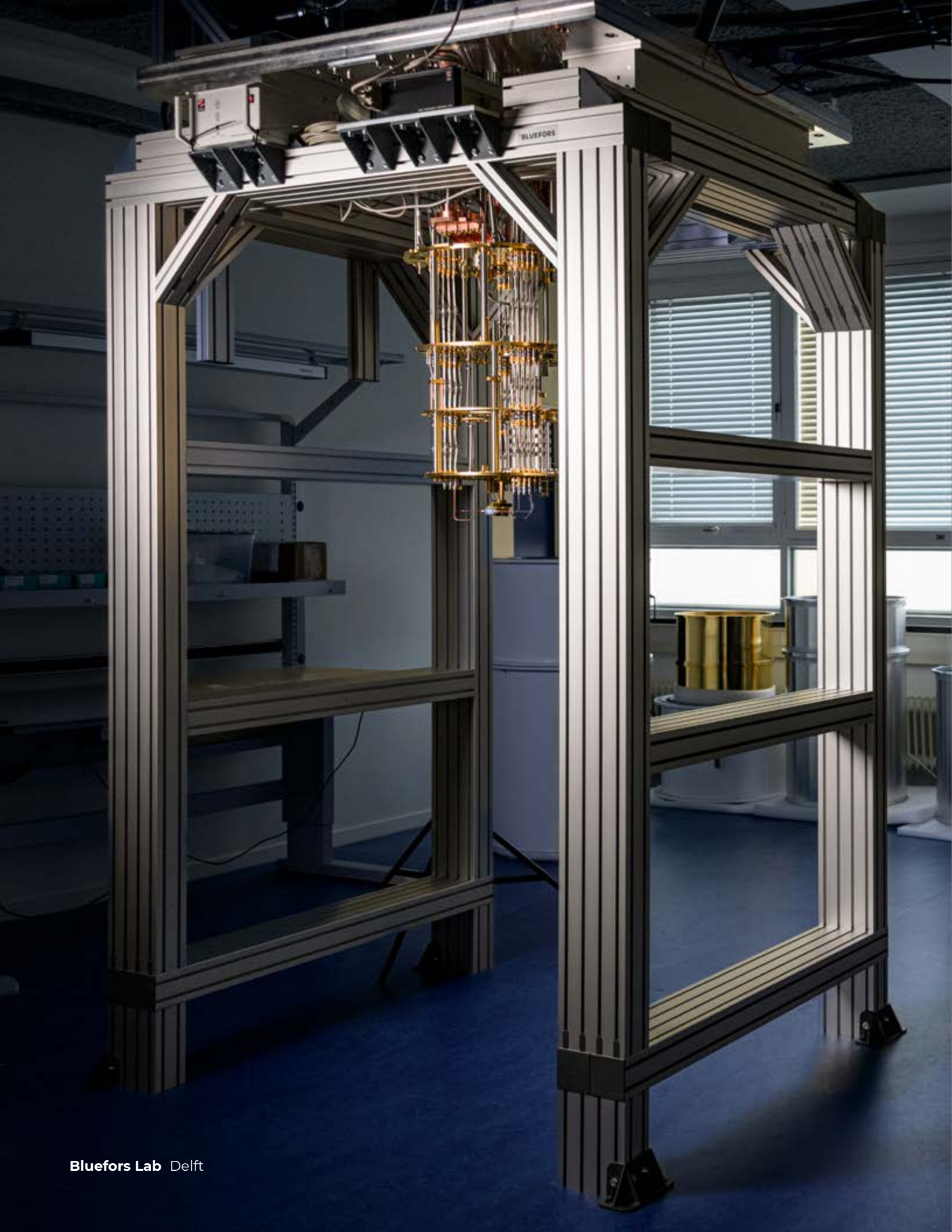
We have come a long way, and we will never stop. Our team designs for the future, and we are there for our customers with unmatched flow and support throughout their journey. What we did with dilution refrigerators transformed the research community. Now, we're helping you transform your industry.

Bluefors - Cool for Progress.

Ready to hear more?

Get in touch with Bluefors and Cryomech Sales.





Applications

Bluefors Products in Use

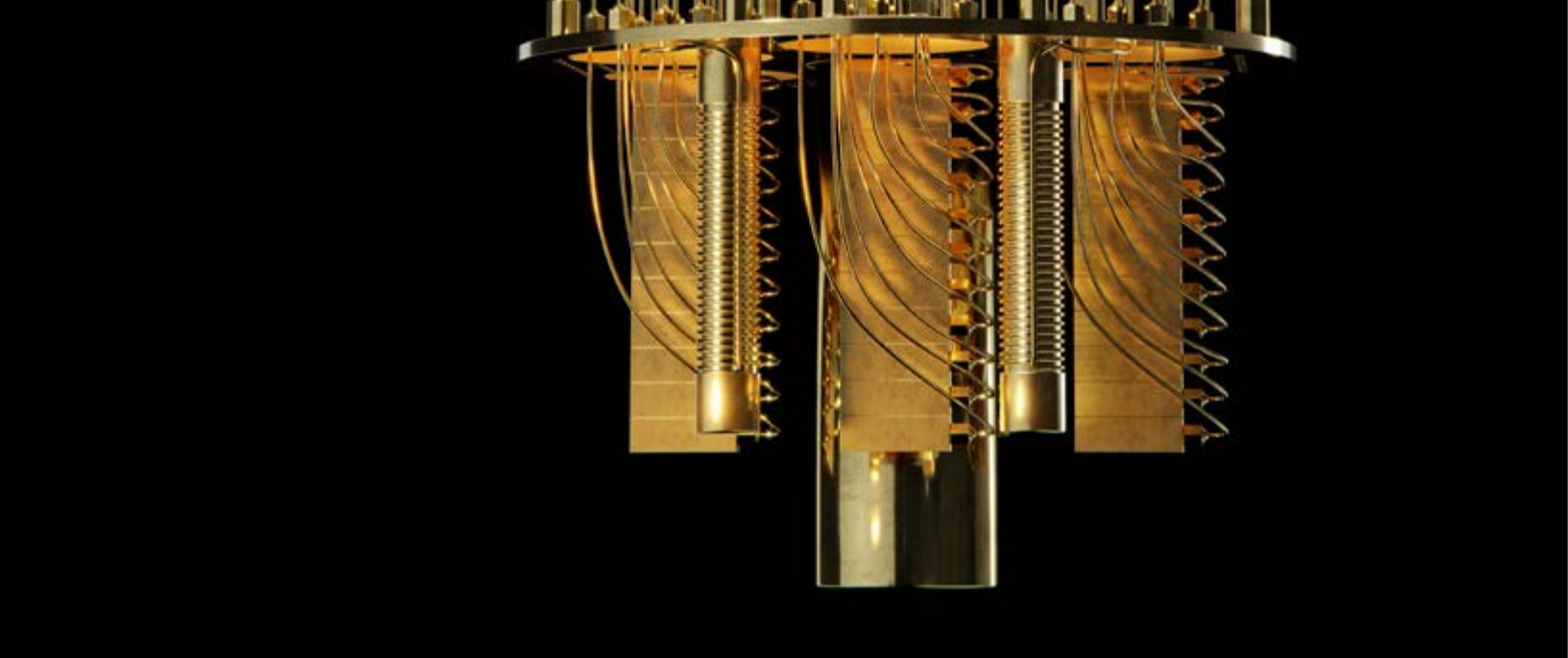
Customers around the world rely on Bluefors Cryogenic Measurement Systems and Cryocoolers for many different types of research and applications.

From studying molecular activity to looking back in time to the far reaches of the universe, our products are used to cool scientific apparatus down to the ultra-low temperatures needed.

The cold temperatures our systems enable drive cutting-edge research into quantum technologies, low temperature physics, medical and life sciences, and energy production.

Read more about the different types of applications our systems are used for on Bluefors.com





Quantum Technology

Enabling the Future of Quantum Technology

Every day, developments in quantum technology bring us towards the next wave of technological leaps that will transform our daily lives.

The scientific advances made through controlling quantum behavior hold the potential to revolutionize communications, medicine development, navigation, and our understanding of the universe.

At Bluefors, we enable the future of quantum technology with our essential cryogenic solutions for quantum research. Our dilution refrigerators are the global benchmark for the ultra-low temperature cooling systems needed in quantum applications. Whether it's quantum computers, quantum communications, quantum sensors, or another quantum technology, we are dedicated to supporting your work in transforming the world.

Quantum Computing

There are many different approaches to quantum computing, characterized by the qubit modalities used. Quantum computers utilizing superconducting circuits are one of the most common, requiring temperatures near absolute zero that Bluefors dilution refrigerator measurement systems provide.

Other modalities, such as spin qubits, trapped ions, or photonic quantum computing, while operating at higher temperatures, still require cryogenics for the whole system or specific parts of the systems that need cooling. For these purposes, besides our DR systems, we offer 1K Systems, 4K Systems, Pulse Tube Cryocoolers, and Cold Helium Circulation Systems.

Quantum Technology

Our systems are also used in the development of

other quantum technologies. Quantum sensing, for example, provides highly accurate sensors and measurements used in atomic clocks, imaging, or navigation systems. Superconducting devices, trapped ions, spin-qubit systems, and nitrogen-vacancy centers are some of the modalities employed.

Another field of research is quantum communication. Quantum key distribution uses the quantum properties of photons to provide complex encryption, opening the possibility for significantly enhanced telecommunication security.

Quantum Materials

Quantum materials are materials which don't behave according to laws of classical physics. Superconductors and topological materials are some examples of such materials.

Quantum materials research fuels the development of quantum technologies. Understanding novel materials with never-before-seen properties opens up new pathways for many types of research and development in quantum technology fields.

Cryogenic Measurement Systems and Cryocoolers for Quantum Applications



Dilution Refrigerator Measurement Systems

Bluefors cryogen-free dilution refrigerator measurement systems are the global benchmark for ultra-low temperature cooling systems.



1K Systems

We offer a wide range of systems that enable users to conduct experiments at temperatures down to 0.5 K.



4K Systems

We offer a range of 4K systems that enable users to conduct experiments down to 4 K.



Pulse Tube Cryocoolers

Our Cryomech Cryocoolers are a core component in many kinds of quantum applications, providing the highest cooling capacities.





Low Temperature Physics Research

Cryogenic Products for Physics Research

Some of the most groundbreaking physics research is carried out at low temperatures. The reason for this is that material properties—for example, thermal conductivity—change as the materials become colder, and some phenomena only occur at cryogenic temperatures.

Low temperatures are also needed to create environments with as little interference as possible from noise sources that might influence the researched phenomena. From astrophysics to materials science, low temperatures are vital for research.

Materials Science

At cryogenic temperatures, there are significant changes in the behavior of certain material properties. Depending on the material, electrical and thermal conductivity might increase, heat capacity might be reduced, or resistance effectively eliminated, leading to superconductivity. Magnetic properties might also increase, and mechanical properties change.

Our low and ultra-low temperature cooling systems enable research into semiconductors, the development of high temperature superconductors, material characterization studies, and much more.

Astrophysics and Cosmology

Astrophysics and cosmology research allows us to better understand our universe, its formation, and the different astronomical objects that exist within it. There are multiple fields of study – including cosmic microwave background research, gravitational waves, and dark matter – many of which utilize our products to achieve the low temperatures required in research.

High-Energy Physics

In the quest to study the fundamental nature of matter, high-energy physics explores what the universe is made of and how it works. Research in

this field uses particle accelerators to create collisions of high-energy particles. Bluefors offers a unique horizontal dilution refrigerator system—the Bluefors LH System—for beamline and detector applications in high energy physics.

Neutrino Science

Neutrinos are the most abundant particles in the universe, but are hard to detect. Neutrino detectors are often very large chambers located deep underground to provide isolation from cosmic rays and background radiation. Cryomech Cryocoolers (such as the AL600) have been used to cool liquid argon cryostats that aid in the discovery and study of neutrinos.

Cryogenic Measurement Systems for Physics Research



XLDsl Dilution Refrigerator Measurement System





SD Dilution Refrigerator Measurement System





LD Dilution Refrigerator Measurement System





LH Dilution Refrigerator Measurement System



Cryocoolers for Physics Research



Pulse Tube Cryocoolers





Gifford-McMahon Cryocoolers





Medical and Life Sciences

How Low Temperatures Help to Advance Medical and Life Sciences

Medical and life sciences help us develop our knowledge of the biological world to find solutions that improve, for example, healthcare. The discipline includes fields such as medicine, clinical sciences, biotechnology and other medical sciences. The research carried out seeks to understand or illuminate the underlying phenomena to achieve scientific or technological advances that benefit us through the application of medical or clinical improvements.

Within medical and life sciences, there are many areas where the use of low temperatures is vital. At Bluefors, we support these fields by providing reliable cryogenic products for low temperature research and operation, and the sustainable management of the liquid helium utilized in many of the systems.

Nuclear Magnetic Resonance Spectroscopy

Nuclear Magnetic Resonance (NMR) spectroscopy is the leading technique for determining the structure of organic compounds. NMR requires very strong magnetic fields, sometimes over 20 tesla. We provide helium recovery and reliquefaction solutions, and our cryocoolers can be used to create zero-loss or dry magnets.

Magnetic Resonance Imaging

Magnetic Resonance Imaging (MRI) uses superconducting magnets to create a strong magnetic field. We offer solutions for pre-cooling and cooling superconducting magnets used in MRI.

Magnetoencephalography

Magnetoencephalography (MEG) is a non-invasive technique for mapping brain activity. MEG systems

have thousands of SQUID sensors to do the measurements, all cooled to 4.2 K using liquid helium. Our Cryomech Liquid Helium Management Systems are used with MEG systems to deal with the helium boil-off.

Fourier Transform Mass Spectrometry

A Fourier Transform Mass Spectrometer (FTMS) is a type of mass spectrometer that analyzes the cyclotron frequency of ions when trapped in a magnetic field. Bluefors offers solutions where the superconducting

magnets used in these systems are cooled using our Cryomech Pulse Tube Cryocoolers. Our Cryomech Cold Helium Circulation Systems are also used for magnet pre-cooling.

Proton Therapy

Proton therapy is a type of radiation therapy that can be more precisely targeted at a tumor, making it a less invasive treatment method. Our Cryomech Cryocoolers are used to cool the superconducting magnets essential for proton therapy.

Cryomech Liquid Helium Management Products



Liquid Helium Plants

Cryomech Liquid Helium Plants allow users to liquefy helium from any room temperature source, enabling liquid helium management.





Helium Reliquefiers

Cryomech Helium Reliquefiers are easy to install, and intended for helium recovery from a single helium-consuming device.

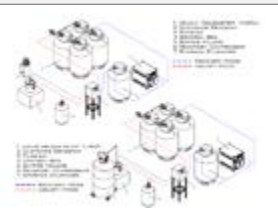




Helium Recovery Systems

Cryomech Helium Recovery Systems enable laboratories to manage their helium consumption, providing large-scale helium recovery.





Compact Recovery Systems

The Cryomech Compact Recovery System is a cost-effective option for helium management, especially for low boil-off applications.





Clean Energy

Cryogenics for Clean Energy Production

The need for more climate friendly energy production methods is essential, as the world seeks ways to halt or reverse the effects of climate change. In addition to renewable energy, clean energy production plays a vital role in addressing the climate crisis by reducing or eliminating any air-pollutants caused as by-products of the energy production process.

Bluefors technology is used in two fields playing a key role in clean energy production: the hydrogen industry, and fusion research. Both require cryogenics in their energy production processes, which we support with our Cryomech Cryocoolers.

Hydrogen Industry

The hydrogen industry is seen as playing key role in decarbonizing production and transportation methods. The rapidly growing hydrogen economy brings carbon footprint reductions to many different industries, from steel production to chemical manufacturing, helping to mitigate greenhouse gas emissions. Hydrogen cells also have the potential to offer near-zero-emission transportation fuel for international marine shipping and aviation.

For efficient transportation, gaseous hydrogen must be liquefied by cooling it below 20 K. During storage, hydrogen boil-off must also be managed to reduce losses. This is where cryogenics enters the picture: our Cryomech Cryocoolers are ideal for these purposes.

Cryomech Cryocoolers for Hydrogen Production



Pulse Tube Cryocoolers

The largest variety of industry-leading Pulse Tube Cryocoolers, with the highest capacities and a reputation for reliability.





Gifford-McMahon Cryocoolers

With our wide range of Cryomech Gifford-McMahon Cryocoolers, we guarantee you'll find the perfect product for every application.



Cryocoolers for Fusion Magnets



AL630 Gifford-McMahon Cryocooler

The AL630 is our highest capacity 20K GM Cryocooler, providing 100 W of cooling capacity at 20 K.





AL325 Gifford-McMahon Cryocooler

The AL325 is a good alternative when lower cooling power is needed. It provides 100 W of cooling capacity at 25 K.





[READ NEXT](#)

**OpenStar Technologies:
How Cryogenics Enables Next
Generation Nuclear Fusion
Research**

4 min read | December 19, 2023





Systems

Dilution Refrigerator Measurement Systems

Bluefors cryogen-free Dilution Refrigerator Measurement Systems are industry-leading, top-of-the-line cooling systems. They provide continuous cooling at ultra-low temperatures through the dilution process of helium-3–helium-4 mixture in a closed-loop environment.

Our latest systems deliver more control than ever before, with fully automated cooldown from room to base temperatures < 10 mK.

Bluefors Systems have extensive additional options available to create an optimal system configuration based on experiment needs. Systems are available in multiple configurations, and are compatible with an extensive range of measurement infrastructure and superconducting magnets.

Read more about our Dilution Refrigerator Measurement Systems on [Bluefors.com](https://bluefors.com)



Dilution Refrigerator Measurement Systems

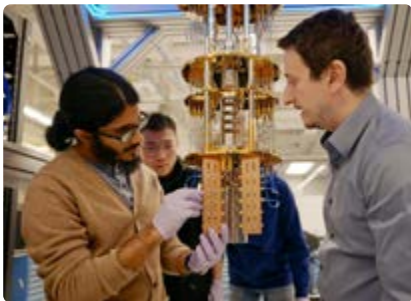
Bluefors cryogen-free Dilution Refrigerator Measurement Systems are the global benchmark for ultra-low temperature cooling systems.

Our industry-standard systems provide continuous cooling at ultra-low temperatures through the dilution process of helium-3–helium-4 mixture in a closed-loop environment.

The cooldown from room temperature is initiated at the push of a button, and systems can be operated and controlled fully remotely.



The global benchmark in ultra-low temperature cooling.



[READ NEXT](#)

Utilizing Synthetic Quantum Materials to Study Many-Body Systems

8 min read | February 10, 2025



Product Highlights

- ✓ **Fully Automated Operation**
Fully automated cooldown sequence from room to base temperature, initiated with a single push of a button.
- ✓ **Low Total Cost of Ownership**
Oil-free pumps and compressors in the Gas Handling System guarantee minimal maintenance requirements, with a service interval up to 3 years.
- ✓ **Temperature Controller**
Enhances the user experience of our cryogenic systems. With a modern and intuitive user interface, you gain direct control and overview of the system's temperature status.
- ✓ **Extensive Options and Integrated Products**
Systems can also include measurement infrastructure and superconducting magnets, depending on your needs.
- ✓ **Reliable**
Not a single soft solder joint from the dilution refrigerator cooling unit to the vacuum space, including a fully welded main heat exchanger.
- ✓ **Superior Performance**
Low base temperatures with superior cooling power, and fast cooldown times.

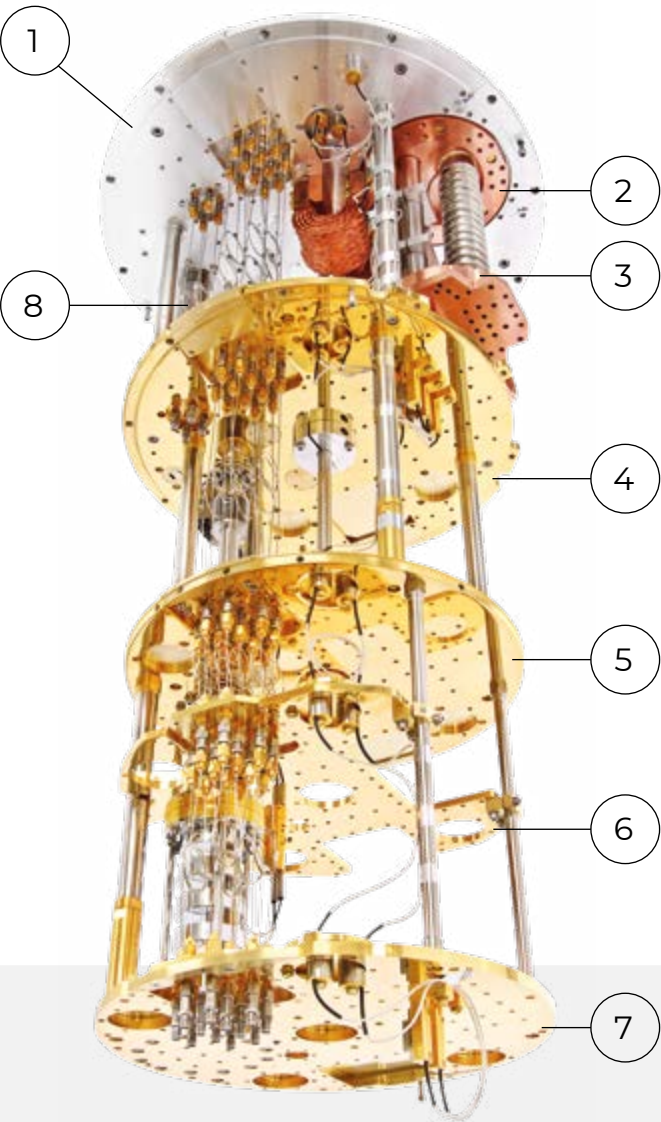


Principle Parts of a Cryostat

The cryogen-free dilution refrigerator (DR) with closed helium cycle is a measurement system for ultra-low temperatures in the range of 7 mK to 4.2 K.

This provides a measurement environment with minimal thermal noise. These types of systems are essential in the research fields of nano- and quantum technologies, radio astronomy and particle-physics with novel radiation detectors.

The cryostat is the main device that achieves and maintains the low cryogenic temperatures. It is connected to the Gas Handling System cabinet by three lines: the Still Pumping Line, the helium-3 return line and the vacuum can pumping line. All these lines have electric isolators in them to separate the cryostat from the Gas Handling System.



Cryostat insert layout

- | | |
|-----------------------------------|-----------------------|
| 1. 50K Flange | 5. Still Flange |
| 2. Pulse tube 1st stage Cold Head | 6. Cold Plate |
| 3. Pulse tube 2nd stage Cold Head | 7. MXC Flange |
| 4. 4K Flange | 8. Still Pumping Line |

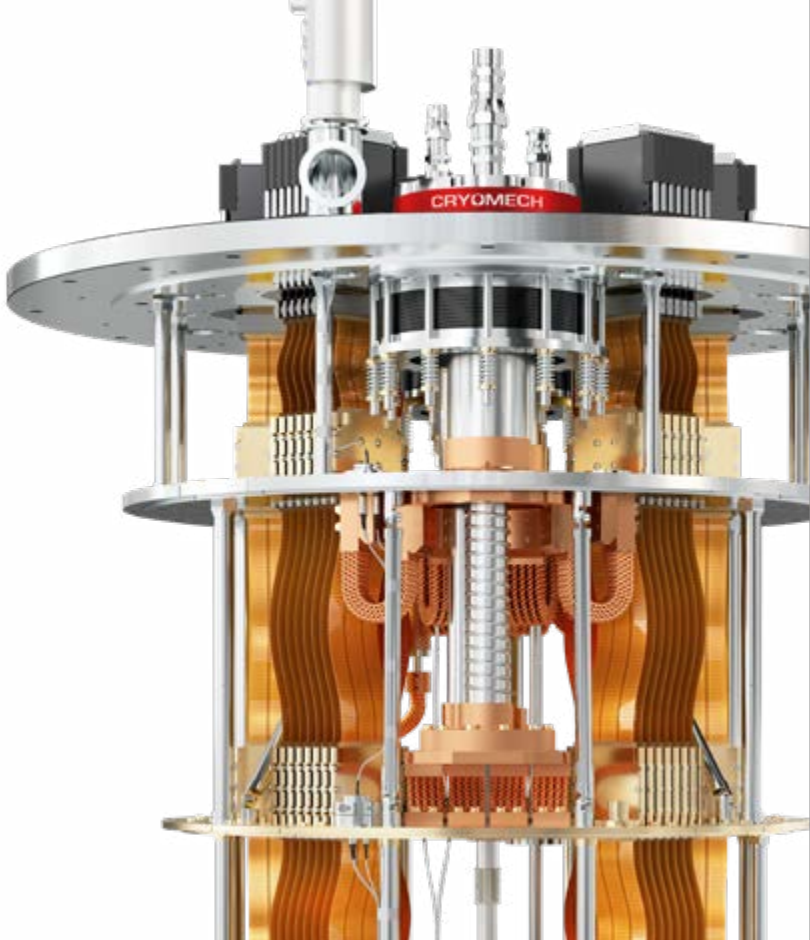


Enhanced Cooling NEW

An optimized pulse tube integration significantly enhances the cooling performance of XLD and LD systems.

The combined expertise of the Bluefors and Cryomech research teams has resulted in the development of highly-optimized cooling performance improvements for our dilution refrigerators.

Enhanced systems significantly improve the integration of the pulse tube, allowing elevated 4K flange temperatures to deliver up to 3x higher cooling power, enabling greater experimental loads and faster cooldown performance.



Product Highlights

✓ **More cooling to cool more**

The enhanced cooling power increases the amount of measurement infrastructure that can be installed in systems, allowing you to scale up experiments. Cooling power at 3 K temperatures is doubled, while the maximum cooling power at the 4K flange is tripled.

✓ **Elevated 4K flange temperatures**

The temperature range at the 4K flange has been extended up to ~4.5 K without affecting operation of the dilution refrigerator.

✓ **Stable performance**

The wider 4K flange temperature range delivers extra stable performance for the dilution unit, and a more stable environment for superconducting magnets.

✓ **Same form factor**

The enhanced pulse tube design takes the same

space in the cryostat, so no changes are required for user experiment setups.

✓ **Vibration performance**

Enhancements made to the pulse tube integration also enable better low-vibration performance.

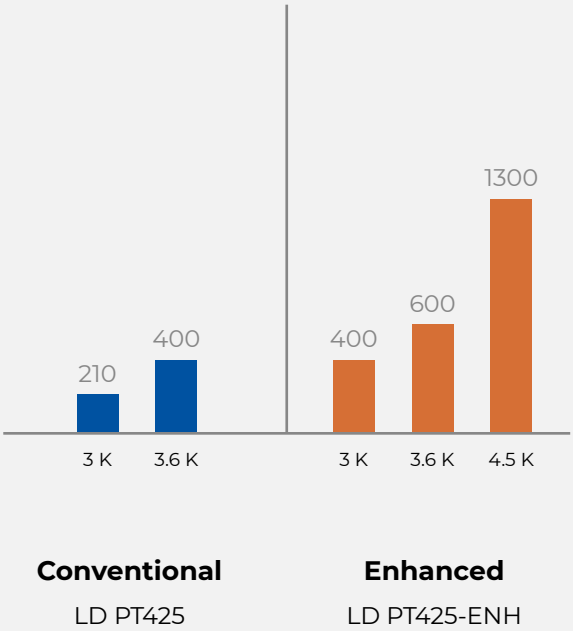
✓ **Cool faster**

Faster cooldown times enable a more rapid turnaround, especially when the load is directly attached to the 4K flange (i.e. magnets), helping you get experiments up and running without delay.

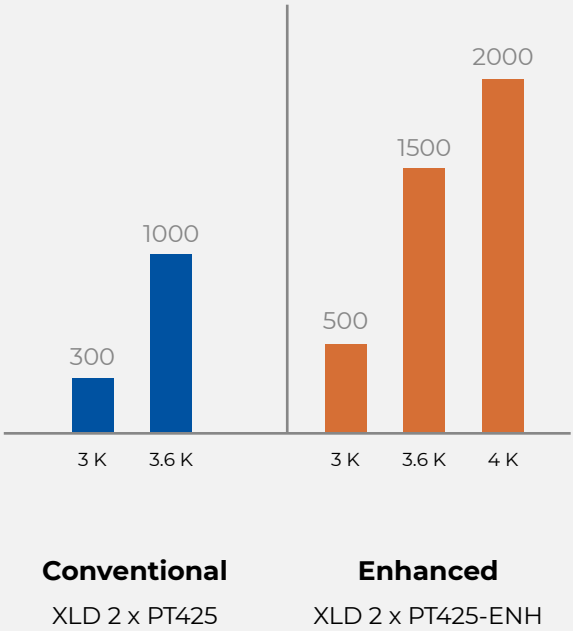
✓ **Exclusively for Bluefors systems**

Enhanced cooling performance is a design integration that is exclusively available for Bluefors LD and XLD Dilution Refrigerators. The enhanced pulse tube cryocoolers are not available for other systems.

LD Comparison



XLD Comparison



Data shown from prototype system, not final specifications.



Putting our cold heads together

The improvements made with our enhanced cooling pulse tube integration are an example of the research & development collaboration and

excellence that can only be achieved through the combined expertise of Bluefors and Cryomech product development teams.

System Comparison

Cooling	SD	LH	LD250	LD400	LD400sl	XLD400sl	XLD1000sl
Standard pulse tube configuration	1 x PT410	1 x PT415	1 x PT415	1 xPT415-ENH	1 x PT415-ENH	2 x PT415	2 x PT425-ENH
Other available pulse tube models	PT415, PT420, PT425, PT310	PT420, PT425	PT420, PT425, PT310	PT425-ENH, PT310-ENH	PT425-ENH, PT310-ENH	2 x PT420, 2 x PT425, PT310 & PT425	PT310-ENH & PT425-ENH 3 x PT425-ENH PT310-ENH & 2 x PT425-ENH
Guaranteed cooling power (μW) at 20 mK	N/A	>10	>12	>14	>14	>14	>30
Guaranteed cooling power (μW) at 100 mK	>250	>250	>250	>400	>400	>400	>1000
Guaranteed base temperature (mK)	<30	<10	<10	<10	<10	<10	<10
Cooldown time (h)	<12	<24	<24	<24	<24	<24	<30
Mechanical features	SD	LH	LD250	LD400	LD400sl	XLD400sl	XLD1000sl
MXC Flange diameter (mm)	148	294	294	294	294	500	500
Dilution Unit placement	edge	edge	edge	edge	edge	center	center
Dilution Unit type	short	horizontal	standard	standard	standard	standard	dual
Ultra-Compact Compatibility			Yes	Yes	Yes		
Standard Experimental Ports*	SD	LH	LD250	LD400	LD400sl	XLD400sl	XLD1000sl
KF25	1						
KF40	2	4	5	5	4	7	7
ISO-K63		2	2	2			
Side-loading ports					2	6	6
Maximum number of coaxial cables	14 (SMA)	70 (SMA)	77 (SMA)	77 (SMA)	336 (HDW) & 28 (SMA), 92 (SMA only)	>1000 (HDW)	>1000 (HDW)

*The number of available ports depends on the options and wiring configuration.

XLDsl

The XLDsl accommodates up to 1008 factory-installed semi-rigid 18 GHz coaxial lines in a configuration with two pulse tubes. Its side-loading feature allows experimental wiring to be prepared away from the cryostat while the system is running.

Even with its extensive capabilities and superior performance, a fully automated cooldown sequence from room to base temperature can still be carried out at the push of a single button.

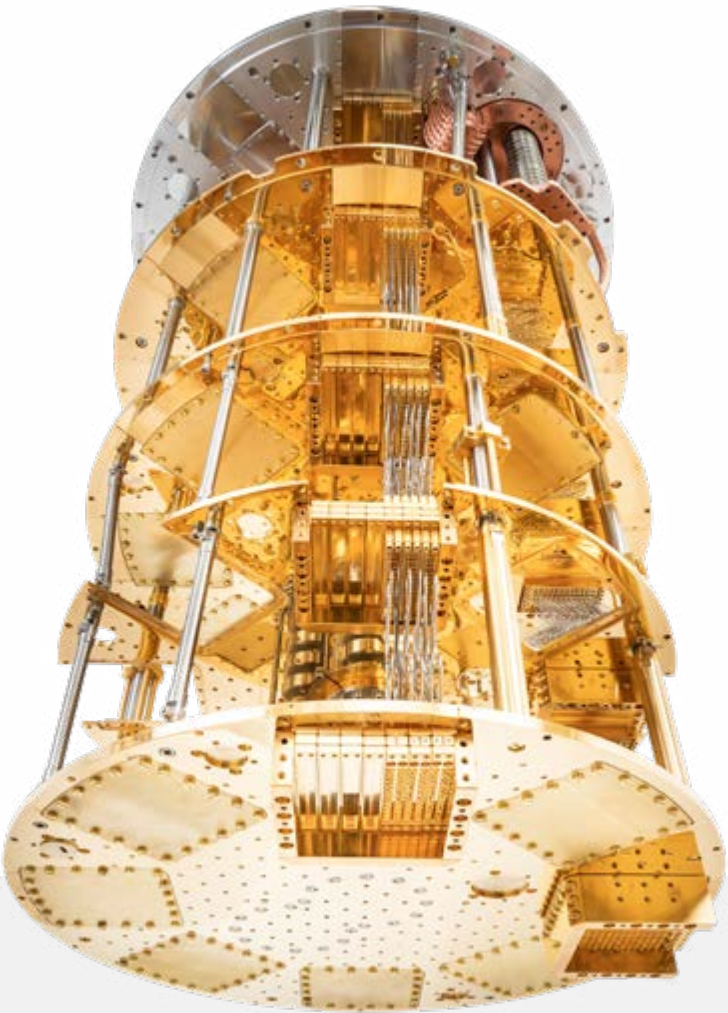
Extensive Wiring. Vast Experimental Space.

The XLDsl System features a variety of access ports between the Room Temperature and the Mixing Chamber Flanges, the primary ports being the six side-loading line-of-sight (LOS) ports for experimental wiring.

- 6 x Side-loading ports (LOS)
- 3 x KF40 (LOS)
- 4 x KF40
- Mixing Chamber Flange: ø 500 mm | 20"

The system is compatible with our modular High-Density Wiring options, enabling high scalability for experimental wiring, especially for high-frequency signals.

A centrally-placed unit distributes the cooling evenly around the Mixing Chamber Flange. The open design permits easy experiment access without the heat exchangers or support structure obscuring access.



Side-Loading

The side-loading feature allows wiring assembly work for the installation set flanges to be performed on a work bench away from the cryostat.

Consequently, the preparation of a wiring assembly or a full experiment can be performed while the system is running. When the system is warmed up to room temperature, the assembly can be immediately exchanged, greatly reducing the room temperature idle time.

Preparing and exchanging the installation set assembly is carried out using a dedicated installation tool that provides the mechanical stability and maintains correct spacing between flanges when the assembly is not mounted into the cryostat.

LD

The LD System has the largest amount of available options and different magnet configurations, allowing it to be customized for different experiments and uses.

The LD400 system typically provides more than 15 μ W at 20 mK on the experimental flange with only 18 liters of helium-3. It has a high cooling power of ~ 0.5 mW when operated at 100 mK.

This well-engineered dilution refrigerator measurement system has a clean and open design for installing measurement equipment.

Fully Featured for Superior Performance

Automated operation

A single push of a button initiates a fully automated cooldown sequence from room to base temperature.

Large experimental space

The off-center placement of the dilution unit maximizes useful space on all flanges. An open design permits easy experiment access without heat exchangers or the system support structure getting in the way.

- Base temperature below 10 mK
- Fast cooldown: < 24 hours to 10 mK
- Mixing Chamber Flange: $\varnothing$ 294 mm | 11.42"

Access ports for experimental wiring

A variety of access ports between the Room Temperature and the Mixing Chamber Flange.

- 2 x ISO-K63 slotted in all flanges
- 5 x KF40 including central port



LD400sl NEW

The LD400sl System matches the performance of our standard LD400 systems, adding 2 side-loading ports, to enable the simple and convenient installation of our measurement infrastructure modules.

The side-loading ports in the LD400sl make it possible to install our High-Density Flex (FPC) Wiring and High-Density Wiring options. The side-loading options are also 100% compatible with our XLD systems, making the LD400sl the ultimate testing system with interchangeable wiring across LD and XLD systems.

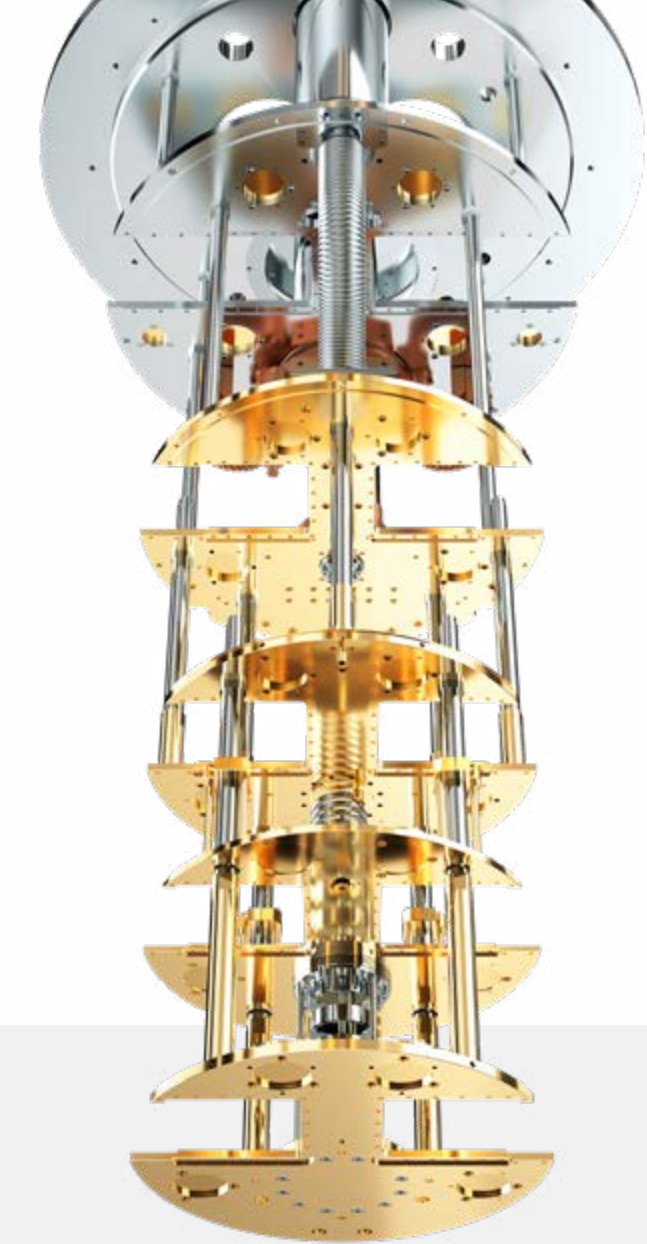
Proven Performance Plus Advanced Wiring Flexibility

Easy assembly

The side-loading feature enables easy assembly and maintenance for large wiring infrastructures. The assembly preparation can be performed on a workbench while the system is running, and immediately exchanged when system reaches room temperature.

Higher payloads

The side-loading feature in LD400sl systems is particularly beneficial for complex customer experiments with higher payloads, or quantum applications with a large number of qubits in a compact cryostat.



Interchangeable wiring

Side-loading compatibility allows the LD400sl to be used as a fast test system, and scaling up experiments from LD to XLD systems is easier than ever.

Enhanced Cooling

With the new enhanced 4 K cooling feature, the LD400sl can now better handle both passive and active heat load from the expanded wiring and cryogenic components enabled by the side-loading port.

Ultra-Compact LD NEW

The Ultra-Compact LD System is an all-in-one, compact cryogenic measurement system based on our LD systems.

The new, compact, cryogenic measurement system is ideal for laboratory environments with limited space, and is designed to operate silently with low vibration, making it perfect for noise-sensitive environments.

The layout integrates the cryostat, gas handling system, and pulse tube compressor into a tidy, easy-to-access, compact system that fits anywhere.

All-in-one Powerhouse.

Compact. Flexible. Accessible.

As an all-in-one system, the Ultra-Compact LD gives you the freedom to place the system wherever you need it in your lab. And when it comes to operating and carrying out experiments, the system includes an integrated 19" rack with 10U space for additional measurement electronics.

Proven LD Performance

The Ultra-Compact LD system is available with the same performance specifications as our LD400 or LD250 systems. There are a variety of access ports for experimental wiring, with 2 x ISO-K63 slotted in all flanges, and 5 x KF40 including a central port.

The large mixing chamber diameter of 294 mm (11.42") provides full access to an experimental space that can be cooled to <10 mK in less than 24 hours.

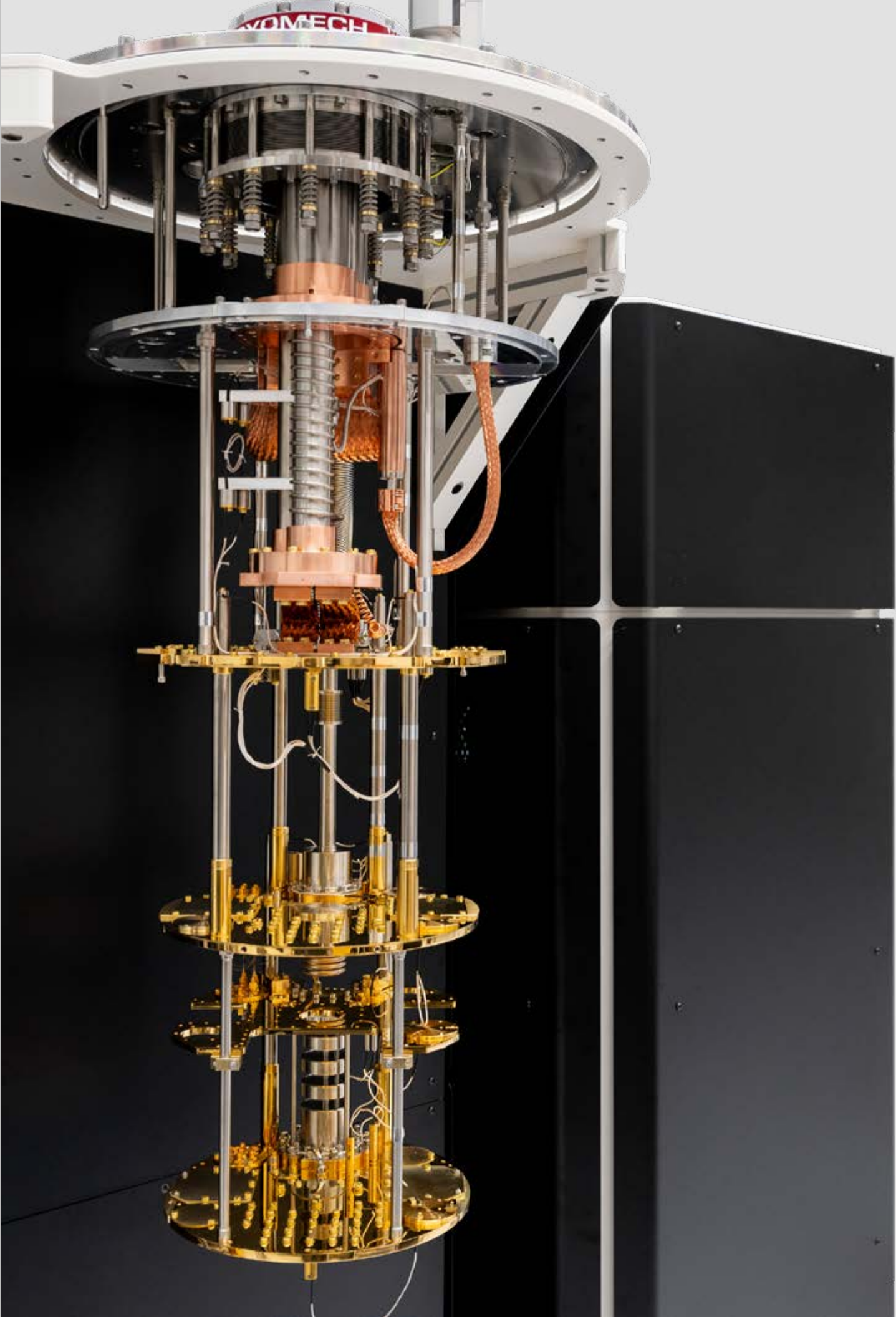


Vibration Dampening

The system utilizes multiple dampening solutions, to deliver low-vibration operation. The pulse tube ballast tanks and remote motor have their own vibration isolation. The pulse tube compressor is installed on a vibration isolation platform, and the frame has been made extra rigid by the use of diagonal frame supports.

Silent Operation

The sound level is 10-16 dBA lower compared to the standard LD system in a frame. The silent operation is ideal for labs where the measurement system is installed in the same space as users' workstations.



SD

To create a fast turnaround cryogenic refrigerator, we revived the form factor of our first cryogen-free dilution refrigerator measurement system. Our SD system delivers a cooldown time of < 12 hours, providing a cooling power of > 250 μ W when operated at 100 mK.

The system requires no lab layout or on-site installation, and with the reduced step heat exchanger stage, the required amount of helium-3 is only 12 liters, making the system effective and affordable.



Compact. Fast. Effective.

Compact layout

The SD system has a compact layout as the Control Unit is integrated into the Gas Handling System, and the dimensions of the system frame are only 1 410 mm by 1 000 mm. The system doesn't require a lab layout or on-site installation, but it is still recommended for new customers.

Fast, automated cooldown

The fully automated cooldown sequence takes the system from room temperature to 30 mK in under 12 hours.

Effective simplicity

The dilution unit is positioned off-center to provide maximum useful experimental space on all flanges.

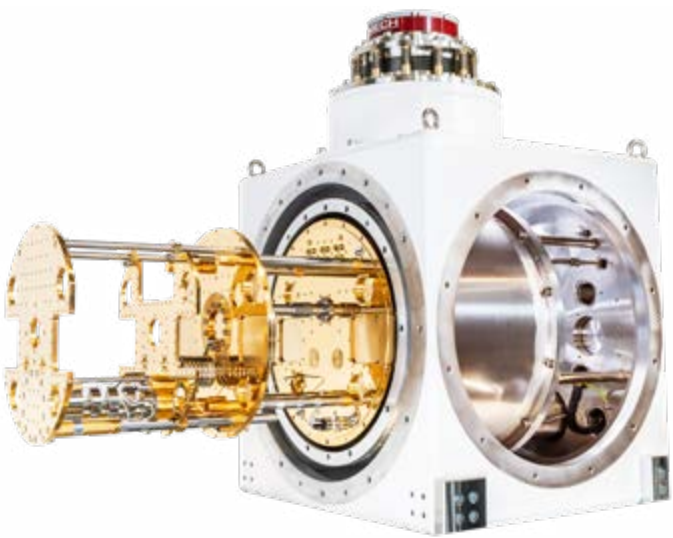
- Base temperature well below 30 mK
- Three access ports (2 x KF40, 1 x KF25)



LH

The Bluefors LH System is a unique horizontal dilution refrigerator measurement system that is capable of operating under different tilt angles. It comes with special shields with removable blinds, which are easily modified into optical access ports.

These features make the LH System ideal for beam line, telescope, or detector applications, and is the preferred system for astrophysics research.



Uniquely Cool – From Any Angle.

Superior performance

The LH system offers similar performance to Bluefors LD systems in a unique, horizontal format.

- Base temperature below 10 mK
- Fast cooldown: < 24 hours to 10 mK

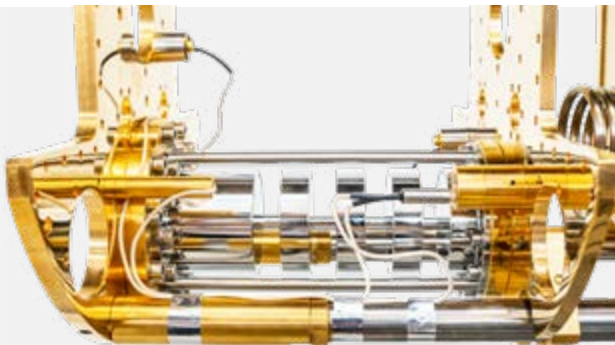
Extensive capabilities for experimental wiring

All line-of-sight ports extend from room temperature to the Mixing Chamber.

- 2 x ISO-K63 slotted in all flanges
- 4 x KF40

Fully automated operation

Fully automated cooldown sequence from room to base temperature, initiated with a single push of a button.



XLDHe High Power System

The XLDHehp provides extremely high cooling power and rapid cooldown times for experiments in the 1 K temperature range.

The XLDHehp is a cryogen-free measurement system that utilizes helium-4 to deliver extremely high cooling power between 200-700 mW at 1-1.2 K. It is ideal for applications in the 1 K temperature range, such as single photon detectors for photonic quantum computers, or spin qubit quantum computing devices (when fitted with optional integrated magnets).

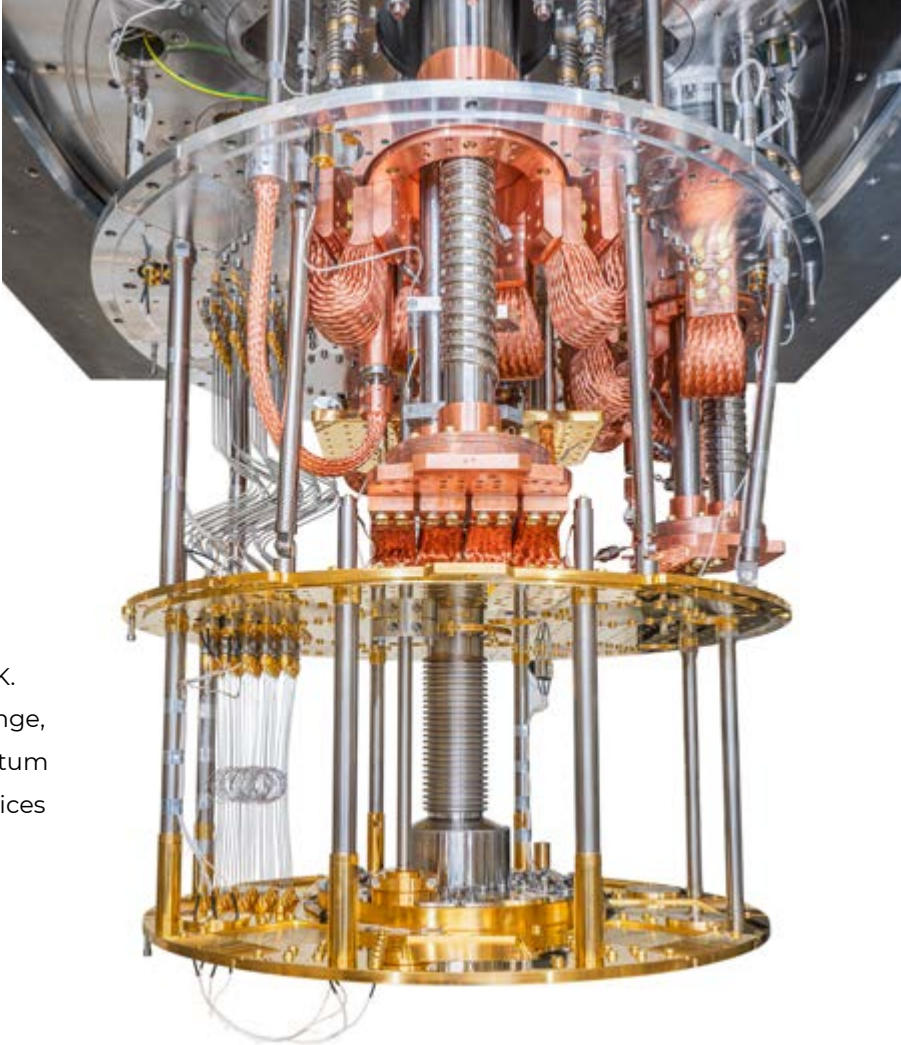
The system features side-loading ports for fast exchange of experimental wiring, and a large experimental flange of 520 mm. A configuration with integrated superconducting magnets and additional payload space is also available.

This vast cooling power and space provide enormous flexibility, and the fast turnaround system enables opportunities to scale up the number of experiments carried out.

Product Highlights

- ✓ **Ultimate Cooling for 1 K Experiments**
- ✓ **Triple Pulse Tube and Fast Turnaround Options**
- ✓ **Fast Exchange of Wiring with Side-Loading Feature**
- ✓ **Unique Wiring Capabilities**
- ✓ **Vast Experimental Space**
- ✓ **Magnet Integration**

Note: The cooling power is measured on the Evaporator flange. The experimental space is measured on the bottom of the Evaporator flange. The cooldown time to base temperature is measured on an empty system with a standard experimental space and shield set.



XLDHeHP	Guaranteed
Base temperature	<900 mK
Cooling power at 1 K	200 mW
Cooling power at 1.1 K	400 mW
Cooling power at 1.2 K	700 mW
Cooldown time to base temperature (empty system).	3 x PT425 and a short experimental space: <12 hours
Optional LN2 pre-cooling loop available for faster cooldown time (<9 h with 2-section vacuum cans).	2 x PT425 and a very long experimental space: <16 hours
Experimental space	Ø520 mm
Vertical experiment space	175 mm (2-section) 776 mm (3-section)

Cryogenic Wafer Prober

The Cryogenic Wafer Prober enables testing of cryogenic quantum devices, electronics and detectors at temperatures below 2 K, measured from the surface of the wafer.

The Wafer Prober provides fast sample characterization, with a throughput up to 100 times faster than commonly used cryogenic chambers, enabling volume probing for up to 300 mm wafers. The system can be operated fully automatically.

The Cryogenic Wafer Prober was developed together with AEM, who have long experience in building automated wafer-level test systems.



Cryogenic Wafer Prober	
Wafer size	300 mm, 200 mm, and 150 mm
Travel	±160 mm XY, 0–40 mm Z, ± 4 ° Theta
XY – Accuracy	±20 µm
Travel speed	Up to 35 mm/s XY, fully adjustable
Wafer base temperature	< 2 K
Wafer exchange time (measurement-to-measurement)	~ 3 h
Wiring capacity	Up to 768 single DC lines Up to 48 RF lines (either 18 GHz or 40 GHz operation)
Wafer loading	From FOUP / magazine or manually to load lock

Note: Base temperature is measured from the surface of the wafer.



Systems

Gas Handling System Generation 2

Highly advanced. Intelligently automated. Our new Gas Handling System delivers next-level control with unprecedented ease-of-use, class-leading safety and enhanced reliability.

The Gas Handling System is the beating heart that powers every Bluefors system. Used by customers around the world in highly demanding environments, the Gas Handling System and Dilution Refrigerator must operate reliably and consistently over the lifetime of the products.

The next generation of our Gas Handling System includes extensive new hardware solutions and control capabilities that give you all the power and functionality you demand, in a system designed for the quantum future.

Read more about the Gas Handling System Generation 2 on [Bluefors.com](https://bluefors.com)





Reliable. Flexible. Powerful.

Designed with reliability, unprecedented ease of control, improved safety and the future in mind.

Our new Gas Handling System utilizes the latest industrial solutions to take system control to the next level.

Redesigned for the Quantum Future

Future-Proof, Modular Industrial Design

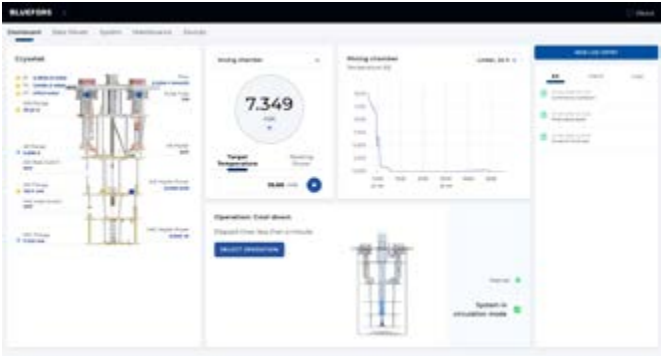
The tidy, modular design with the latest technology improves not only usability and functionality, but also safety. The stackable design also helps make better use of space. With a lockable front door providing easy access, the new Gas Handling System makes maintenance and upgrades painless.

The modern electronics and software platform also simplifies connectivity and measurement infrastructure upgrades.

Generation 2 is a platform that will keep evolving with new features, long into the future.

High performance with reliability

- Long system lifetime
- Improved reliability and durability
- Easier to use and operate
- Higher user & customer satisfaction
- More peace of mind
- Built-in industrial computer with optimized control and processing power (PLC system) with EtherCAT communication
- Latest generations of pumps and sensors
- New Control Software running on optional high performance industrial PC with touch screen
- System condition and maintenance status monitoring
- Redundancy in helium mixture circulation
 - Dual liquid nitrogen trap
 - Circulation pumps bypass
 - Optional redundant main pump



Cutting-edge capabilities and usability

- More effective system control
- Easy to operate via Web UI
- More data for advanced diagnostics
- Easy to connect with remote access

All new control software

- Centralized and customizable web application
- Multi-device access
- RESTful APIs, full-duplex WebSockets
- User control & log-in
- Local and external data storage
- New control interfaces built-in (Magnet, Maintenance, Data viewer)
- Bluefors Control Intelligence:
 - Fully automated cooldown
 - Safe mode & recovery protocols
 - System safety warnings and alert
 - Built-in diagnostic procedures
 - Full system status logs

Contact our Sales Engineers to learn more about all the available options.



Upgrade Your System to Generation 2

NEW

Bring all the advantages of our new Gas Handling System to older systems by upgrading to GHS Generation 2.

With a new industrial design, updated hardware, maintenance-free pumps, and powerful new Control Software, the new Gas Handling System Generation 2 brings older systems into the future.

Any existing GHS Gen 1 system can be upgraded to benefit from all the new features, regardless of system age.

Take advantage of the additional modular options and the powerful web-based control software to bring new functionality and power to your systems.



	Gas Handling System Generation 1	Gas Handling System Generation 2
Design and construction	Classic	All-new industrial grade design
Electronics and control system	Microcontroller	All-new PLC with EtherCAT, EMC certified
Control software	Classic	All-new, web-based, with optional industrial PC and touch screen
Modularity	No	Modular units with improved usability and safety features
Configurability	Limited	Feature packages and options for every use case
Circulation pump	Scroll pump	Multistage roots pump, maintenance-free

Fast Sample Exchange Unit

The Fast Sample Exchange (FSE) System is a fully automatic load-lock system for fast sample loading and unloading.

The movement of the FSE Insert is computer-controlled and delivers an optimized pre-cooling sequence with a sample cooldown time of typically less than 9 hours.

The load-lock mechanism comes with a smart controller that prevents accidental venting of the vacuum chamber and conflicting operation of the FSE Insert and FSE Gate Valve. The loading mechanism can also be operated via the control software or directly from the FSE Control Unit.

Technical Specifications

In the Bottom-Loading FSE System, experimental wiring is located mainly in the cryostat and the wiring is connected to the bottom-loading Sample Holder at the Mixing Chamber Flange.

There is a grounding wiring option available, which protects the sample while loading the FSE Insert into the system.

Available diameters are 48 mm, 58 mm, and 78 mm for both LD and XLD Systems. The FSE Insert diameter is determined by the magnet bore if the system has a magnet.

Base temperature and cooling power are measured at the Sample Holder of the FSE Insert. The provided cooldown time is for a typical configuration.



Features

- ✓ **Fast turnaround**
The FSE System enables a fast turnaround by enabling the rapid exchange of samples without warming up the system..
- ✓ **Prepare samples while measuring**
With multiple FSE Inserts, you can prepare the next sample for experimentation while measuring the current sample in the cryostat.
- ✓ **Easy changing of samples**
Experiments are installed in the sample space in the FSE Insert. With this method, it is not necessary to remove the shields and cans from the system when changing samples.
- ✓ **Protect or bias your sample**
A grounding wiring option protects the sample while loading or unloading the FSE Insert in the system. This can also be used to bias your sample during loading and unloading.



KIDE

KIDE Cryogenic Platform

The KIDE Cryogenic Platform is a cryogenic measurement system designed for large-scale quantum computing.

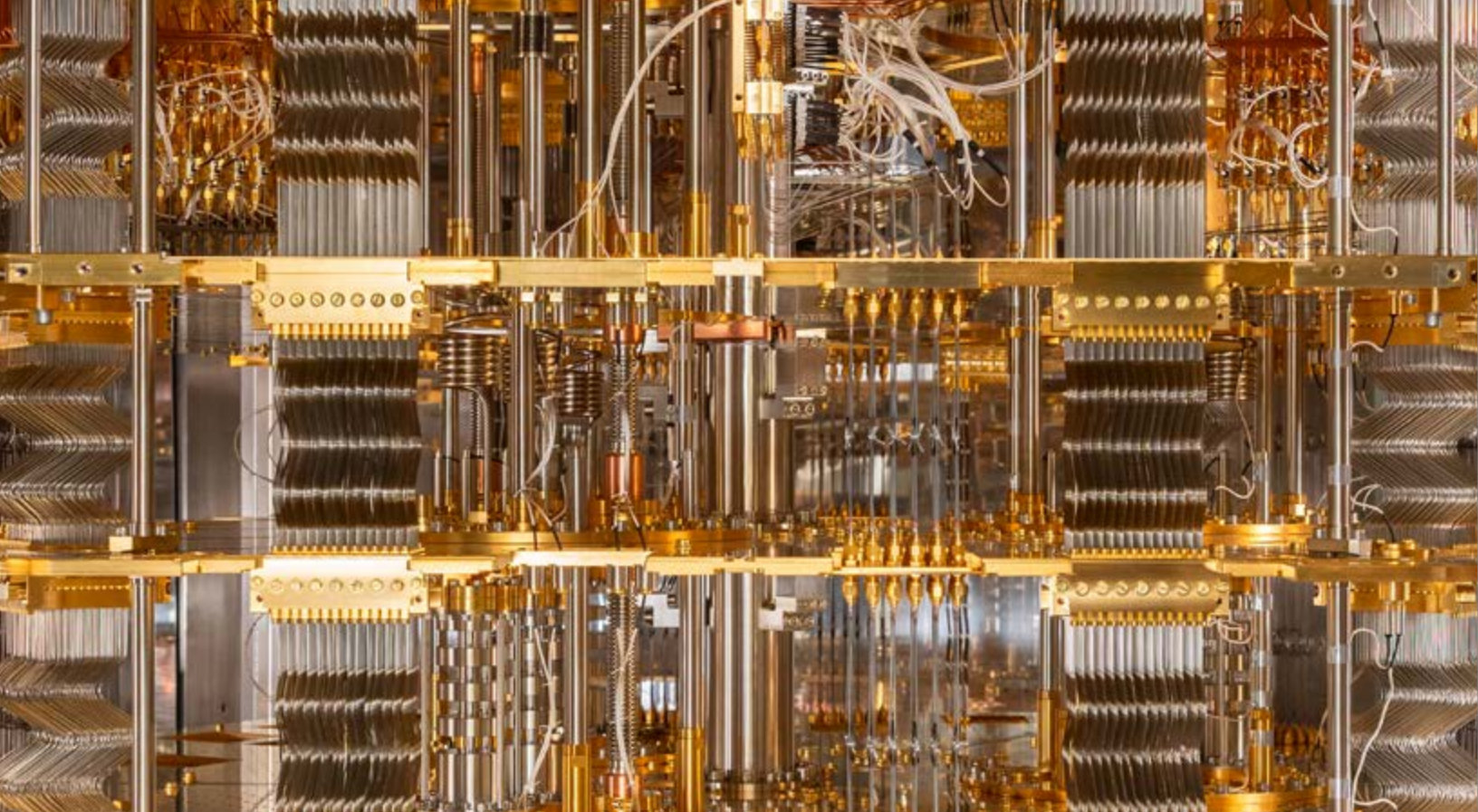
Our large-scale cryogenic measurement system supports the measurement infrastructure required to operate over 1 000 qubits, with a capacity of over 4 000 RF lines and 500 kg of payload.

The system brings unparalleled user access, with doors on the self-supporting vacuum chamber enabling the system to be operated by a single person.

It also offers users enhanced control of the cryogenic technology through separated cooling, enabling user-specific configurations.

Read more about our
KIDE Cryogenic Platform
on Bluefors.com





Product Highlights

- ✓ **Built for large quantum computing infrastructure**

The KIDE Cryogenic Platform is designed for the needs of large-scale quantum computing.
- ✓ **Better control with separated cooling**

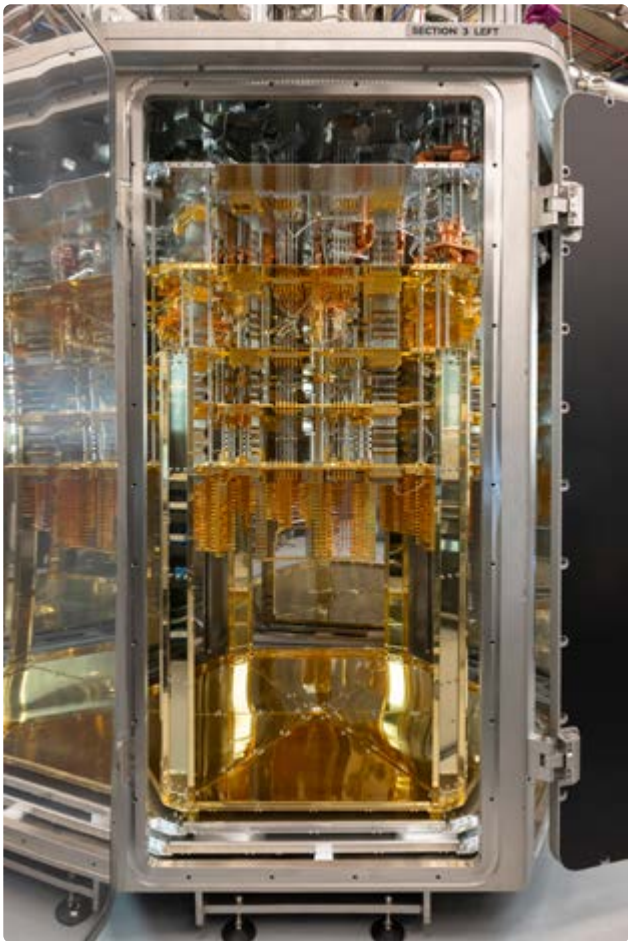
The system enables better control of the cryogenic technology through separated cooling.
- ✓ **Ease of maintenance**

The cooling units of the system are loaded from the top of the system, which enables them to be serviced with minimum affect on the user wiring and components.
- ✓ **Vast wiring capabilities**

The KIDE Cryogenic Platform provides vast wiring capabilities with over 40 available ports, including 24 line-of-sight side-loading ports.
- ✓ **Long cooling cycles**

The KIDE Cryogenic Platform can be run with extended cooling cycles.
- ✓ **Easily accessible payload space**

User access to cryogenic measurement systems has been reimagined and redesigned with the KIDE Cryogenic Platform.



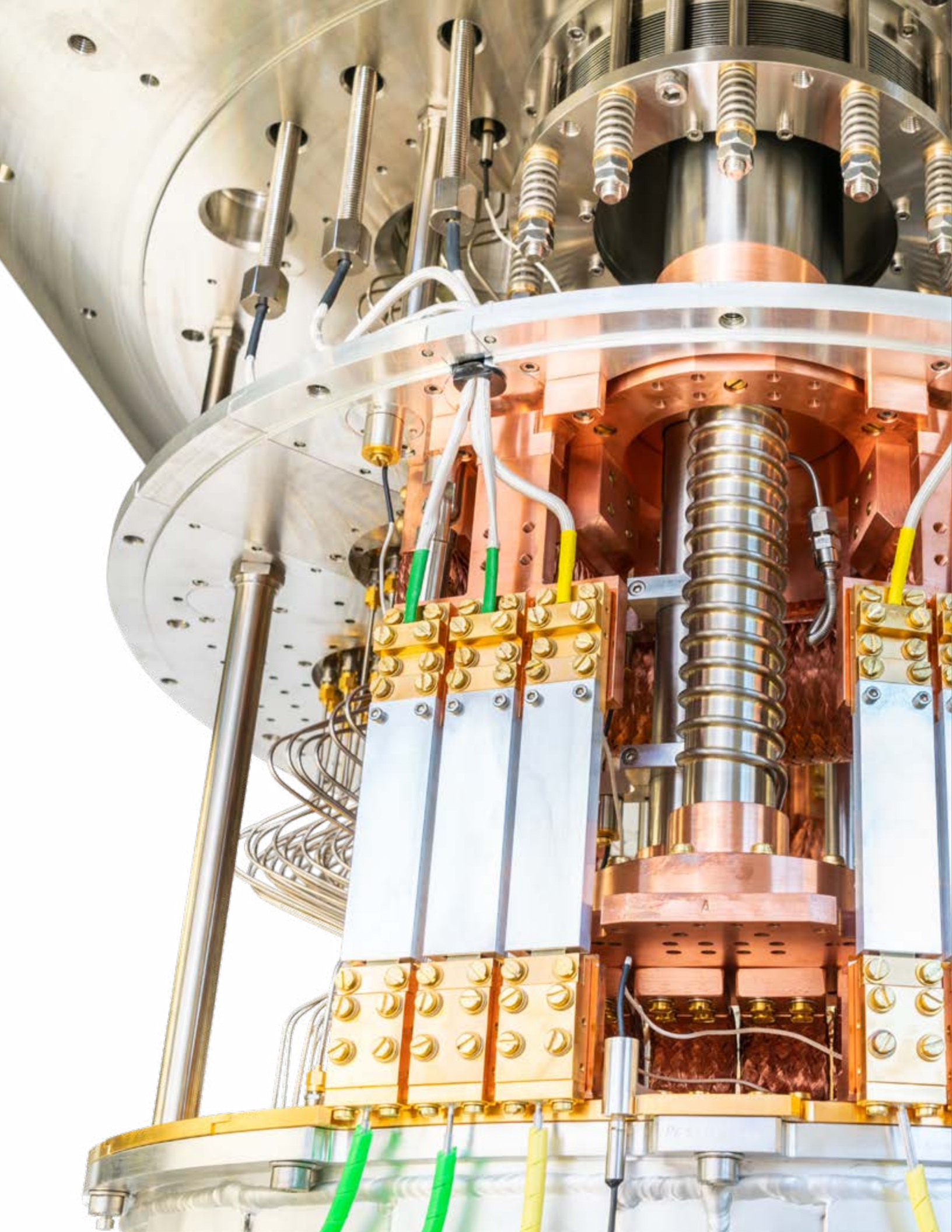
Overview of KIDE

Designed for large-scale quantum computing, KIDE supports measurement infrastructure for over 1 000 qubits.

- Unparalleled access to large payloads
- Capacity for 4 000 RF lines and 500 kg payload
- Self-supporting vacuum chamber
- Multiple access points for easy maintenance
- Operable by one person
- Separated cooling for payload and fridge operation
- Partitioned cold stages allow user-specific configurations for space, cooling power and temperature

KIDE Technical Specifications

KIDE Cryogenic Platform	Typical
Base temperature	10 mK
Cooling power at 20 mK divided to 3 sections	>90 μW
Cooling power at 100 mK divided to 3 sections	>3000 μW
Base Temperature Flange Size	1.6 m²
Wiring Capacity	>4000 RF lines
Maximum Payload Weight	500 kg



Superconducting Magnets

Magnets

We offer integrated cryogen-free superconducting magnets for our cryogenic measurement systems.

A wide variety of Solenoid magnets (up to 16 Tesla) and Vector magnets (up to 9 Tesla on the Z-axis) are available.

Several alternative configurations are possible depending on experimental requirements — for example, incorporation of field-compensated regions, increased field homogeneity, and fitting a persistent switch.

Magnet Features

✓ **Solder-free installation**

Screw terminals for current leads provide a fast and simple magnet installation and removal without soldering.

✓ **Effective heat transfer**

Connection to the 4K flange with a high thermal conductivity tube, which ensures effective heat transfer with a low thermal gradient.

✓ **Power supply quick connection rail**

A quick connection rail for the power supply at room temperature enables easy connection of the magnet to the power supply.

✓ **Integrated magnet temperature monitoring**

Temperature monitoring is possible through the fully integrated Temperature Controller. A sensor on the magnet relays diagnostics for automated monitoring.

✓ **Control magnets with Control Software Gen. 2**

Control Software Generation 2 (for systems with Gas Handling System Generation 2) has a built-in interface to operate magnets and modify their settings.

✓ **Safety certified power supply system**

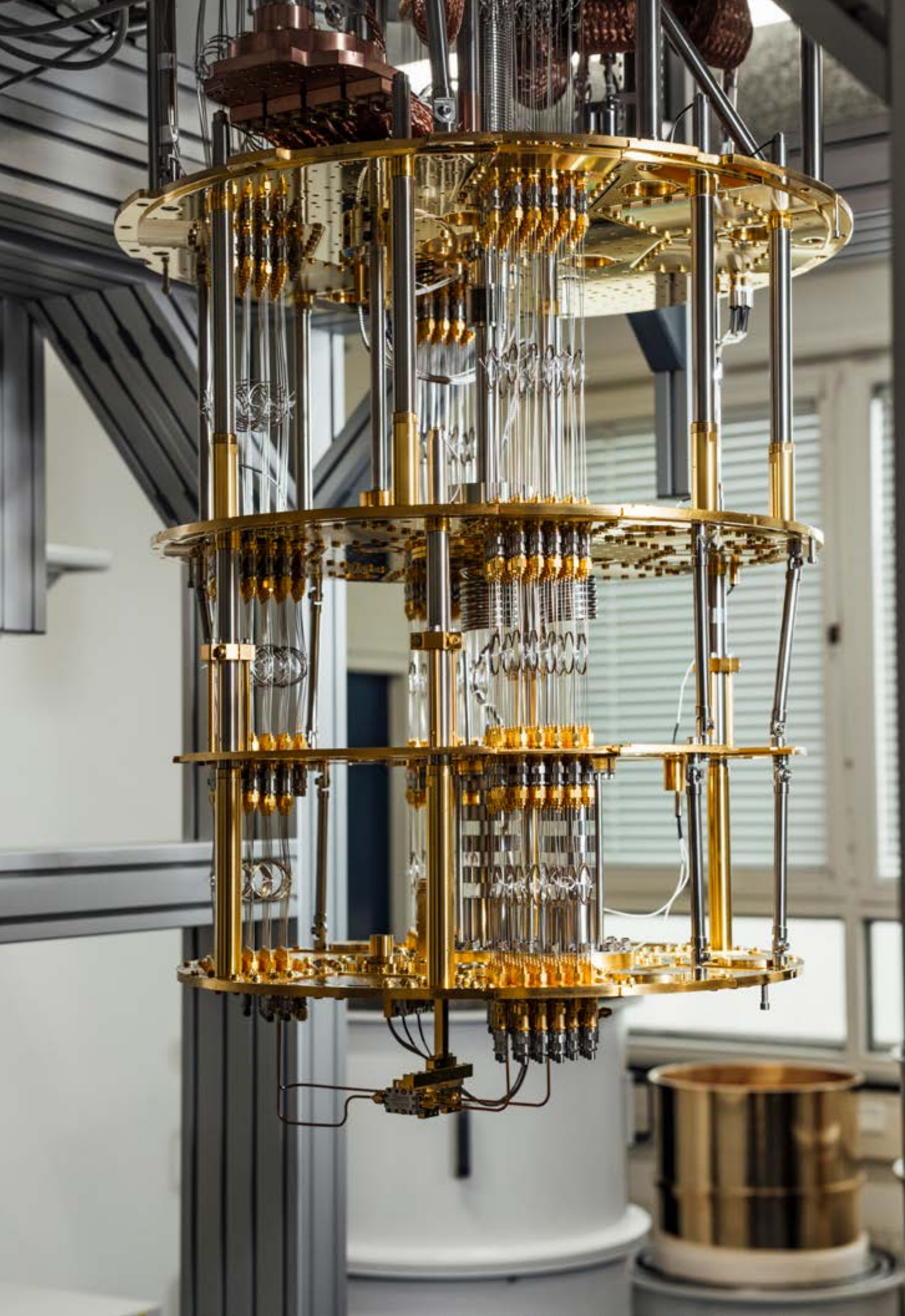
All of our superconducting magnets come with four quadrant power supply system that is safety certified under the CB scheme.

✓ **Persistent Mode Switch**

A persistent mode switch is an option for our Solenoid Magnets. With the persistent mode, the magnetic field has higher stability without continuous current supply.

✓ **Integrated options**

To suit various experimental needs, we have designed different kinds of magnet configurations with options integrated to the magnet solutions.



Measurement Infrastructure

Measurement Infrastructure

Bluefors offers integrated Measurement Infrastructure to provide more complete measurement setups for quantum research and other applications. These include high-quality experimental wiring for DC signals, RF signals, and fiber-optic signals, as well as filtering, signal amplification, and diagnostics solutions.

In cryogenic conditions, the quality of the experimental wiring is extremely important as it directly affects experiment temperatures. Our solutions are reliable, accurate, modular, and designed to deliver optimal performance with our systems.

Read more about integrated Measurement Infrastructure on [Bluefors.com](https://bluefors.com)



Fully Integrated Measurement Infrastructure

At Bluefors, we use our cryogenic expertise to develop high-quality experimental wiring solutions. The standard DC and RF wiring solutions can be modified according to the needs of the experiment.

Various additional solutions are available to enable high-fidelity measurements. These include filtering, signal amplification, and diagnostics options that have been developed and tested to work optimally with our wiring.

For any custom wiring requests or other questions about our measurement solutions, please contact our Sales team.

Product Highlights

✓ **Minimal thermal load**

Bluefors cryogenic wiring is always provided with proper thermal anchoring and heat sinks to reduce the incoming thermal load.

✓ **Low-noise solutions**

The available solutions are low noise, creating as little disturbance to devices as possible.

✓ **Integrated and modular solutions**

All Bluefors wiring has a modular structure, which makes it easier to install and maintain.

✓ **Robust solutions**

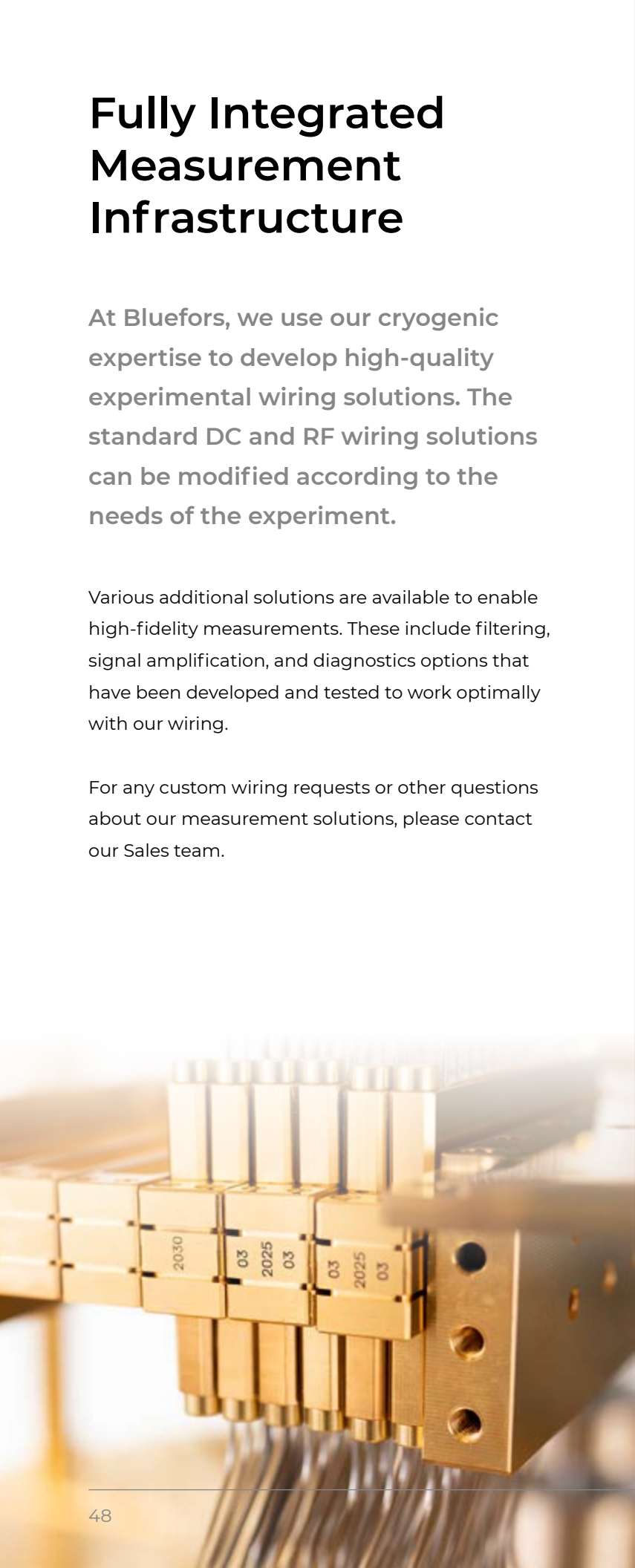
Bluefors has developed all the wiring options to operate reliably and to survive repeated thermal cycling in a cryogenic environment.

✓ **Tested performance**

All factory-installed Bluefors wiring is tested to perform in the cryogenic environment, and not affect system performance with the passive thermal load introduced.

✓ **Boosting measurement fidelity**

Our products enable high-fidelity measurements within the measurement frequency band. Filtering solutions are available to protect devices from unwanted decoherence.



High-Density Flex Wiring (FPC) NEW

Our new, cost-effective, high-density wiring platform utilizes flexible printed circuit (FPC) wiring to deliver enhanced capacity in a continuous form factor to our side-loading systems.

Offering up to 240 channels per side-loading port, the all-new solution delivers a reduced thermal load in a compact package, ideal for microwave drive lines for a large number of qubits in both superconducting and spin qubit systems.

High-Density Flex Wiring (FPC) fits into the side-loading ports of Bluefors XLD and LD cryostats, and can be preassembled before installation. The design allows for 1 to 8 FPCs per side-loading port, and includes all the necessary components from the room temperature control electronics to the experimental flange. The new platform has been designed to enable future options for attenuators and filters, increased density, and low-loss lines.

Performance characteristics*

- Up to 8 lines per port, each featuring 30 channels
- Up to 240 channels per side-loading port
- Frequency range: up to 12 GHz
- Characteristic Impedance: 50 Ohm
- Attenuation (0, 6, 10, 20 dB) and IR filter at MXC
- Connectors: SMPM at MXC; SMA at RT
- Insertion loss (for the full cable from RT to MXC):
10 dB @ 1 GHz, 30 dB @ 6 GHz
- Return loss: 20 dB
- Crosstalk range, NEXT, typical:
-60 dB @ 1 GHz, -40 dB @ 6 GHz

* Preliminary characteristics subject to change

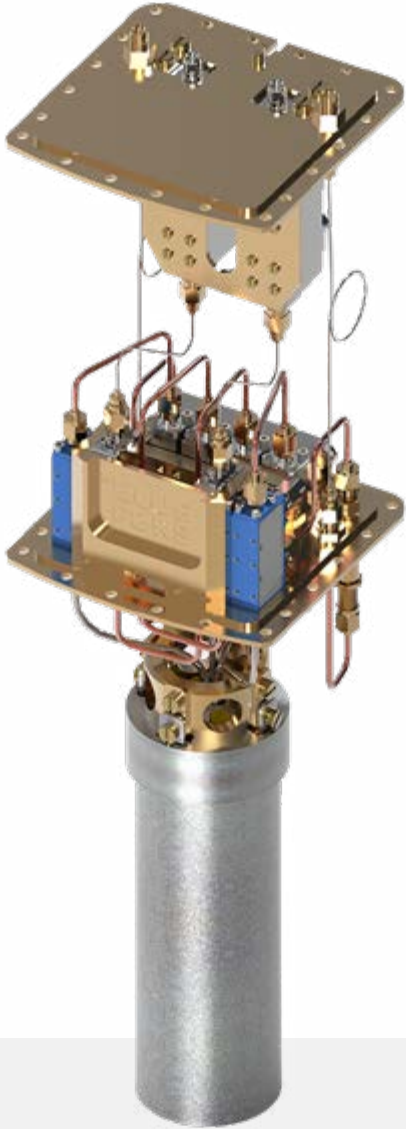


Microwave Readout Module

The Microwave Readout Module is designed to perform near-quantum-limited amplification of signals at millikelvin temperatures.

Preassembled and easily integrated into Bluefors Dilution Refrigerator Measurement Systems, the module includes a traveling wave parametric amplifier (TWPA) and all the connected microwave components needed for a readout line setup.

It offers a wide band of frequencies, supporting multiplexed qubit readouts. The solution can also be used for superconducting sensor and detector readouts. The module provides a high signal-to-noise ratio and reliable performance.



Product Highlights

✓ Readout solution with a TWPA

With the Microwave Readout Module, you can get a complete readout line setup for qubit readouts in one package.

✓ Minimum setup time

The Microwave Readout Module is designed to be a complete and modular solution, enabling easy installation in both XLDsl and LD systems.

✓ High-performing solution

The entire module is optimized for a high signal-to-noise ratio with highly efficient magnetic shielding and integrated noise isolation solutions.

✓ Reliable performance

The module provides consistent and stable performance. It has a high packing density and the TWPA chip has negligible magnetic flux crosstalk.

High-Density Wiring

High-Density Wiring (HDW) is a modular option for Bluefors side-loading systems. In a high-density setup, each side-loading port can be equipped with up to 168 high-frequency lines. This totals up to 1008 lines per system with two pulse tubes.

The modularity and side-loading infrastructure of High-Density Wiring enables easy assembly and maintenance for large wiring infrastructures.

Product Highlights

✓ **High-density wiring form factor**

The High-Density Wiring form factor allows thermalizing and easy connection of components into the system.

✓ **For large scale experiments**

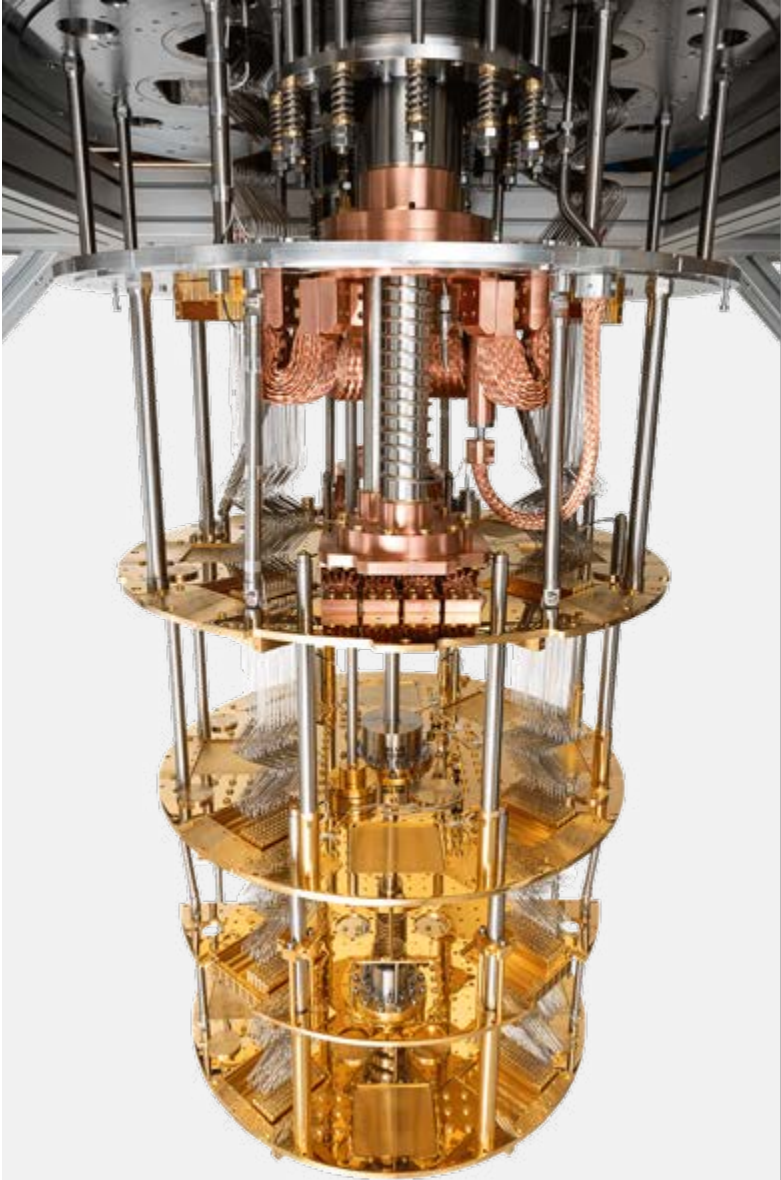
Ideal for experiments requiring large numbers of high-frequency signals spanning from DC to 18 GHz.

✓ **Easy assembly and maintenance**

The modularity of High-Density Wiring enables easy assembly and maintenance for large wiring infrastructures.

✓ **Measurement infrastructure**

The modular form factor can be fitted with custom components for multiple high-density channels, such as filters and attenuators.



Reliable, accurate,
modular, and
designed to deliver
optimal performance
with our systems.

Modular options
for side-loading
systems.

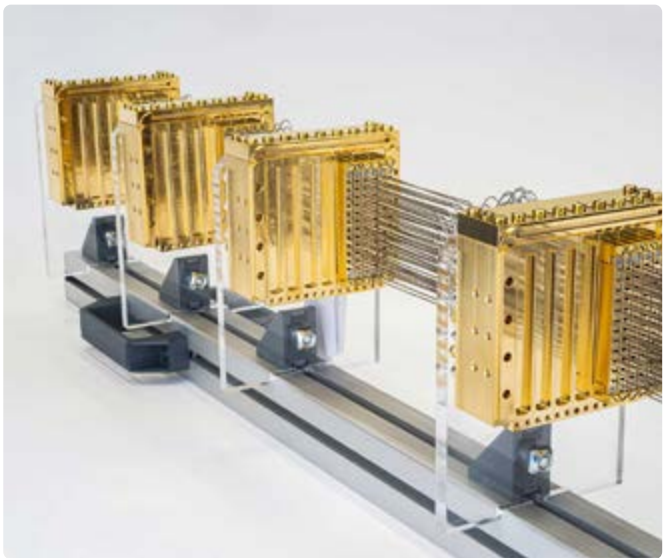


Technical Specifications

High-density Feedthrough

At room temperature, High-Density Wiring is equipped with a hermetic interface for a total of 168 lines. This will always be included regardless of the amount of High-Density Wiring purchased to ensure full upgradability in the future.

The Hermetic Feedthrough is split into 7 modules with 24 lines fitting into each module.



Cables and connectors

The available coaxial cable materials for High-Density Wiring are 0.86 mm SCuNi and NbTi. Coaxial cables have a bandwidth up to 18 GHz and they are arranged into rows of 12 where each row is equipped with a SMPM female multi-connector.

The SMPM multi-connectors are arranged in a modular form factor for up to 14 rows per port. The high-density coaxial cables are sold as set of 24 cables with maximum of 7 sets per port.

Attenuator blocks

At each temperature stage of the system, an attenuator block can be mounted and mated to SMPM multi-connector cable assembly.

Each attenuator block has two rows with 12 channels, and each row of channels can be selected to have one attenuation value (0 dB, 3 dB, 6 dB, 10 dB, or 20 dB).

The wiring set ends at the Mixing Chamber stage in an attenuator block with full-detent male SMPM connectors.

Side-Loading RF Installation Set

Our side-loading modules allow wiring to be assembled onto installation set flanges away from the cryostat on a workbench.

Consequently, the preparation of a wiring assembly or even a full experiment can be performed while the system is running.

Side-loading ports are available on the XLDsl and LD400sl systems.

When the system is warmed up to room temperature, the assembly can be immediately exchanged, greatly reducing the room temperature idle time.

Preparing and exchanging the assembly is carried out using a dedicated installation tool. It provides mechanical stability and ensures the correct spacing of the flanges while mounting the assembly into the cryostat.



The side-loading feature allows the wiring to be assembled onto the installation set flanges away from the cryostat on a workbench.

Comparing Coaxial, High Density and High-Density Flex Wiring

	Semi-rigid Coax	High Density Wiring	High-Density Flex Wiring (FPC)
Lines per port	32	168	240
Total lines in XLDsl system	192	1008	1440
Frequency range	SMA: 18 GHz K/2.92 mm up to 40 GHz	18 GHz	12 GHz
Characteristic impedance	50 Ohm	50 Ohm	50 Ohm
Attenuation	0, 1, 3, 6, 10, 20, 30 dB (all 2W) at 50K, 4K, CP, MXC	0, 1, 3, 6, 10, 20, 30 dB (all 2W) at 50K, 4K, CP, MXC	0, 6, 10, 20 dB at MXC
Filters	IR Filter at all stages. Bandpass filters.	IR Filter at MXC	IR Filter at MXC
Insertion loss (from RT to MXC)	3 dB @ 1 GHz, 7-8 dB @ 6 GHz	3 dB @ 1 GHz, 7-8 dB @ 6 GHz	10 dB @ 1 GHz, 30 dB @ 6 GHz
Return loss	< 20 dB	< 20 dB @ 1 GHz, < 17 dB @ 6 GHz	~ 20 dB
Crosstalk range	Minimal	< -70 dB up to 10 GHz, < -60 dB up to 20 GHz	-60 dB @ 1 GHz, -40 dB @ 6 GHz



Cryocoolers

Pulse Tube and Gifford- McMahon Cryocoolers

Bluefors produces the world's best cryocoolers through the trusted Cryomech brand, building on Cryomech's position as the global leader in cryocooler technology for over 60 years.

Whether you are condensing and liquefying cryogens or conductively cooling your sample, with the largest variety of cryocoolers on the market, we have the perfect solution for every application.

Through a combined portfolio of products, Bluefors and Cryomech keep a visionary eye on the future and push the limits of low and ultra-low temperature cooling.

Read more about our combined portfolio of cryocooler products on Bluefors.com



Pulse Tube Cryocoolers

Cryomech Pulse Tube Cryocoolers are known for their industry-leading capabilities. With the widest variety and the largest capacities available, Cryomech Cryocoolers are highly reliable, offering a mean time between maintenance unmatched by any GM-type Cryocooler anywhere.

Due to our close and collaborative customer relationships, we are proud to provide the best Cryocooler solutions operating between 3-80 K in the world.



Product Highlights

✓ **Easy maintenance**

Cryomech Pulse Tube Cryocoolers offer a long mean time between maintenance and require minimal general maintenance.

✓ **Ideal for vibration-sensitive applications**

With no moving parts, Pulse Tube Cryocoolers are ideal for vibration-sensitive applications. There are also additional options available for the most vibration-sensitive applications.

✓ **Applications in liquid cryostats**

Directly liquefy helium gas and recondense boil-off in liquid cryostats.

✓ **Applications in dry cryostats**

PT Cryocoolers can be used to provide direct conductive cooling in dry (cryogen-free) cryostats. Low-vibration options are also available for these applications.

✓ **Extensive warranty**

Warranty of three years or 12 000 hours, whichever comes first.

Pulse Tube Cryocoolers Comparison

	Model	Compressor Package	Cooling Capacity	Base Temperature
1K PT Cryocoolers	PT415-based	CPA1110	300 mW @ 1.8 K W/ 0.7 W @ 4.3 K	≤1.4 K
	PT425-based	CPA1114	440 mW @ 1.8 K W/ 2.7 W @ 4.3 K	≤1.4 K
2K Two-Stage PT Cryocoolers	PT205	<i>tbc</i>	10 mW @ 2.5 K W/ 100 mW @ 55 K	≤2.4 K
3K Two-Stage PT Cryocoolers	PT310	CPA1114	1.0 W @ 3.0 K W/ 35 W @ 35 K	≤2.3 K
4K Two-Stage PT Cryocoolers	PT403	CP103	0.25 W @ 4.2 K w/ 7 W @ 65 K *	≤2.8 K
	PT405	CPA2850	0.5 W @ 4.2 K w/ 25 W @ 65 K *	≤2.8 K
	PT407	CPA2870	0.7 W @ 4.2 K w/ 25 W @ 55 K *	≤2.8 K
	PT410	CPA289C	1.0 W @ 4.2 K w/ 40 W @ 45 K *	≤2.8 K
	PT415	CPA1110	1.5 W @ 4.2 K w/ 40 W @ 45 K *	≤2.8 K
	PT420	CPA1114	2.0 W @ 4.2 K w/ 55 W @ 45 K *	≤2.8 K
	PT425	CPA1114	2.7 W @ 4.2 K w/ 55 W @ 45 K *	≤2.8 K
	PT450	CPA3027	5.0 W @ 4.2K w/ 65 W @ 45 K *	≤2.8 K
20K Two-Stage PT Cryocoolers	PT803	CP103	4 W @ 20 K w/ 8 W @ 65 K	≤8 K
	PT805	CPA2850	8 W @ 20 K w/ 40 W @ 80 K	≤8 K
	PT810	CPA289C	14 W @ 20 K w/ 80 W @ 80 K	≤8 K
	PT815	CPA1110	22 W @ 20 K w/ 100 W @ 80 K	≤10 K
	PT820	CPA1114	28 W @ 20 K w/ 130 W @ 80 K	≤10 K
30K-80K Single-Stage PT Cryocoolers	PT30	CP103	37 W @ 80 K	≤33 K
	PT60	CP103	60 W @ 80 K	≤33 K
	PT63	CP103	11 W @ 30 K	≤25 K
	PT90	CPA2850	90 W @ 80 K	≤33 K

*With Remote Motor option, cooling power is generally reduced by up to 10%

PT205 NEW

The new Cryomech PT205 is a compact, high-performance, two-stage pulse tube cryocooler for applications in the 2.5 K range.

The PT205 has been engineered to provide efficient cooling power at ultra-low temperatures and is a reliable, low-vibration, energy-efficient and cost-effective option for long-term operations in a wide array of scientific and industrial applications, especially Superconducting Nanowire Single-Photon Detectors (SNSPD). Its compact size also allows it to be easily integrated into limited spaces.

- Cooling Capacity: 10 mW @ 2.5 K and 100 mW @ 55 K
- Base Temperature: ≤ 2.4 K
- Cool Down Time: ≤ 100 min to 2.5 K
- Power Consumption: 1.3 kW at 60 Hz
- Weight: 19 lbs / 8.6 kg

Product Highlights

✓ Low vibration

Thanks to a lack of moving parts, the PT205 is the perfect choice for vibration-sensitive applications that need rapid cooling in the 2-4 K range.

✓ Low cost of ownership

The PT205 has been designed to deliver up to a 30% reduction in long-term ownership costs compared to competing units.

✓ Long life

As a compact but powerful pulse tube cryocooler, the PT205 is a reliable, low-maintenance solution with a high mean time between maintenance.



Cryocooler Customization and Accessories

Scientific research often requires specialized equipment that has never been built before. We take pride in customizing our products so you can easily integrate them into your individual applications.

We are happy to build customized solutions for our customers and their unique applications. Our goal is to provide you with the best possible products while providing the shortest possible lead times.

Customizations include:

- Conflat Flanges
- ISO Flanges
- Gas Feedthroughs
- Electrical Feedthroughs
- Recondensing Heat Exchangers
- Gas Pre-Cooling Tube

Cryocooler Accessories

We offer spare parts for our Cryomech Cryocoolers, providing you with fast access to any vital parts you might need. With spare parts from the original equipment manufacturer, the high-performance level and longevity of your system is ensured. Many different kinds of accessories are also available for our Cryocoolers, to optimize them for different experimental needs.

- Adsorbers
- Helium Flex Lines
- Aeroquip accessories (Elbows, Unions, Feedthroughs, Couplings)
- Replacement Seal Kits
- Helium pressure adjustment accessories
- Vibration management
- Linear power supplies
- Electrical isolators
- Cold Head Sleeve
- Motor Cables
- Toolsets



Gifford-McMahon Cryocoolers

Cryomech’s founder, William Gifford, invented the Gifford-McMahon Cryocooler over 60 years ago.

Since developing the first commercial Gifford-McMahon Cryocooler in 1963, Cryomech has introduced over 10 different baseline models.

Whether you need 10 watts or 600, there’s a GM Cryocooler that’s perfect for every application.



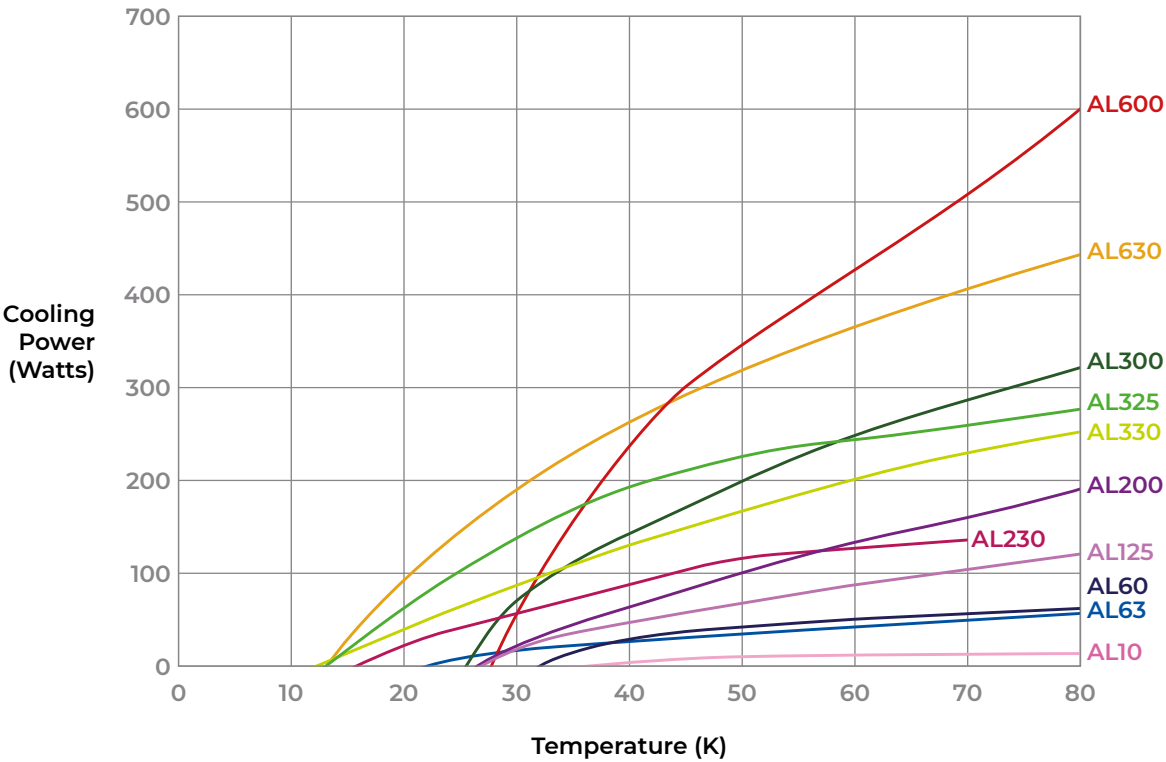
Product Highlights

- ✓ **Easy maintenance**
Most maintenance can be performed in the field. The mean time between maintenance is 10 000 hours.
- ✓ **Ideal for recondensing cryogens**
Ideal for recondensing cryogens in the temperature range of 20 to 125 K.
- ✓ **Extensive warranty**
Warranty of three years or 8 000 hours, whichever comes first.
- ✓ **Widely used solutions**
Cryomech Gifford-McMahon Cryocoolers are in operation on every continent.



Gifford-McMahon Cryocoolers Comparison

	Model	Compressor Package	Cooling Capacity	Base Temperature
20-30K GM Cryocoolers	AL63	CP103	18 W @ 30 K	≤17 K
	AL230	CPA2850	60 W @ 30 K	≤17 K
	AL330	CPA2870	94 W @ 30 K	≤17 K
	AL325	CPA1110	100 W @ 25 K	≤17 K
	AL630	CPA1114	100 W @ 20 K	≤17 K
80K GM Cryocoolers	AL60	CP103	60 W @ 80 K	≤25 K
	AL125	CP103	120 W @ 80 K	≤25 K
	AL200	CPA2850	200 W @ 80 K	≤25 K
	AL300	CPA2870	320 W @ 80 K	≤25 K
	AL600	CPA1114	600 W @ 80 K	≤25 K





Liquid Helium Management Products

Liquid Helium Management

Cryomech Liquid Helium Management Products lead the helium conservation movement with the largest selection of laboratory-scale helium recovery and helium liquefaction options on the market.

Read more about our Liquid Helium Management products on Bluefors.com



Helium Reliquefiers (HeRL)

Single-device, point-of-use liquefaction, integrating a HeRL creates an efficient closed loop with options available to capture transfer/large boil-off spikes.

- Easy drop-in installation through existing fill port
- Can liquefy room temperature helium gas from cylinders
- Powered by a Cryomech Pulse Tube Cryocooler, designed with high reliability and long mean times between maintenance (>30,000 hours of operation)
- Operate 24 hours a day, 7 days a week reliably, automatically and safely
- Warranty of three years or 12,000 hours on parts and materials
- Liquid helium return line connection
- Custom configurations available upon request



Compare specifications:

	HeRL02-RM	HeRL10	HeRL15	HeRL20	HeRL25
Liquefaction Rate	≥ 2.25 L / Day	≥10 L / Day	≥15 L / Day	≥20 L / Day	≥25 L / Day
Reliquefaction and Recondensing Rate	≥ 7.5 L / Day	≥18 L / Day	≥27 L / Day	≥35 L / Day	≥45 L / Day
Cryocooler Model	PT405 / CPA2850	PT410 / CPA289C	PT415 / CPA1110	PT420 / CPA1114	PT425 / CPA1114
Power Consumption (Input Power)	5.4 kW @ 60 Hz 4.9 kW @ 50 Hz	8.4 kW @ 60 Hz 7.8 kW @ 50 Hz	10.7 kW @ 60 Hz 8.0 kW @ 50 Hz	13 kW @ 60 Hz 11.4 kW @ 50 Hz	13 kW @ 60 Hz 12 kW @ 50 Hz
Cooling Water Requirements @ 80°F (27°C)	1.8 GPM (6.8 LPM)	3 GPM (11.5 LPM)	3 GPM (11.5 LPM)	3 GPM (11.5 LPM)	3.6 GPM (13.6 LPM)
Cool Down Time	<4 Hours	<2 Hours	<2 Hours	<2 Hours	<2 Hours

Larger-capacity HeRL's can be manufactured using multiple Pulse Tubes.

Liquid Helium Plants (LHeP)

Single or multiple-device, centralized liquefaction compatible with direct recovery, or a range of helium recovery systems.

- Available in Integrated and Non-Integrated Dewar configurations
- Collect and liquefy boil-off helium gas directly from a single device, multiple devices or recovery systems
- Modular system can be designed around your specific helium needs
- Rugged, stainless steel, liquid helium Dewar available with the following options:
 - Scalable sizes
 - Additional ports for directly accessing liquid helium bath
 - Modified Dewar necks
- Cryogenically insulated extraction line and valve for low loss liquid helium transfer
- Digital touchscreen user interface featuring:
 - Remote monitoring and control
 - Digital level indicator
 - System diagnostics
- Warranty of three years or 12,000 hours on parts and materials
- Dewar operating pressure <5 PSIG

CRYOMECH

Liquefy helium from any room temperature source



Liquid Helium Plants Comparison

	LHeP15	LHeP22	LHeP28	LHeP55	LHeP80
Liquefaction Rate (From Room Temperature Helium)	≥15 L / Day	≥22 L / Day	≥28 L / Day	≥55 L / Day	≥80 L / Day
Dewar Capacity	150 L	150 L	150 L	350 L	500 L
System Dimensions	56 in x 30.5 in x 72 in	56 in x 30.5 in x 72 in	56 in x 30.5 in x 72 in	36 in OD x 85 in H***	42 in OD x 85 in H***
System Weight	790 lb (358 kg)	1040 lb (472 kg)	1040 lb (472 kg)	560 lb (254 kg)***	900 lb (408 kg)***
Cryocooler Model (Water-Cooled Only)	PT410 / CPA289C	PT415 / CPA1110	PT420 / CPA1114	PT420 (2x) / CPA1114 (2x)	PT420 (3x) / CPA1114 (3x)
Power Consumption	8.4 kW @ 60 Hz	10.7 kW @ 60 Hz 9.2 kW @ 50 Hz	12.5 kW @ 60 Hz 11.4 kW @ 50 Hz	12.5 kW @ 60 Hz*(2x) 11.4 kW @ 50 Hz*(2x)	12.5 kW @ 60 Hz**(3x) 11.4 kW @ 50 Hz**(3x)
Cooling Water Requirements	2.3 GPM (9 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)	3 GPM (11.5 LPM) @ 80°F (27°C)
Required Gaseous Helium Flow Rates	7.3 SLPM (0.26 SCFM)	10.7 SLPM (0.38 SCFM)	13.61 SLPM (0.48 SCFM)	26.75 SLPM (0.94 SCFM)	38.89 SLPM (1.374 SCFM)

*The Liquid Helium Plant LHeP55 consists of two (2) separate cold heads; each require its own compressor.
**The Liquid Helium Plant LHeP80 consists of three (3) separate cold heads; each require its own compressor.
*** Cold heads and dewar only.

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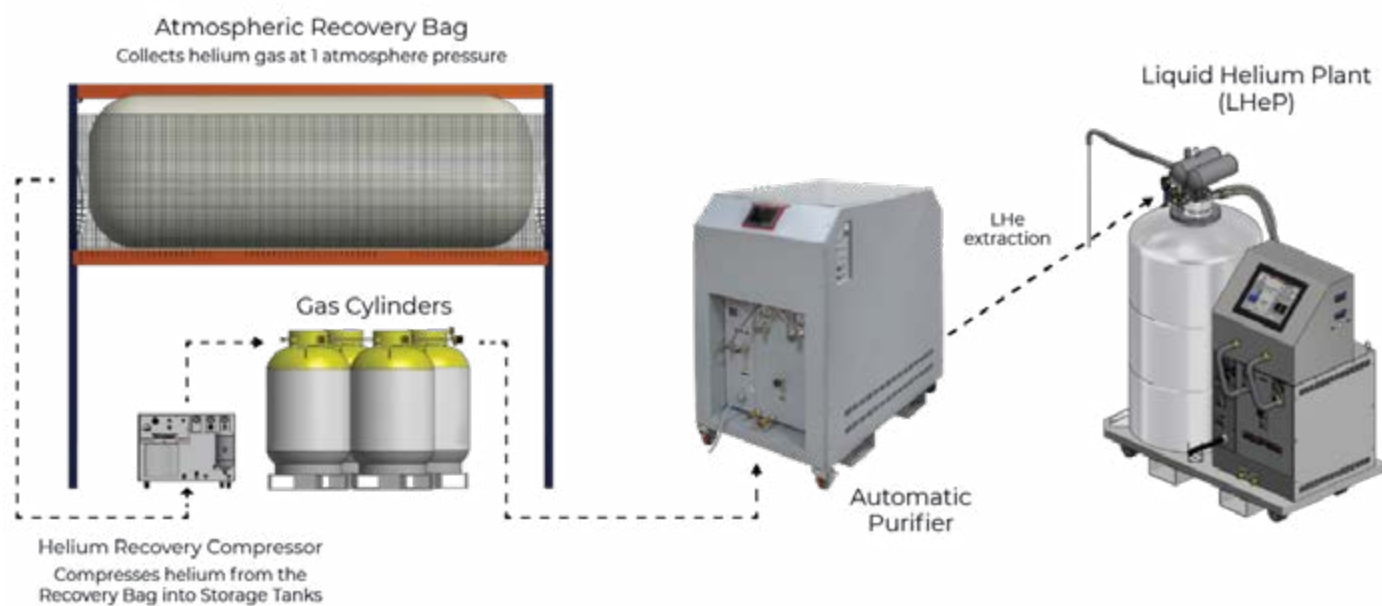
Leading the helium conservation movement.



Helium Recovery Systems

Cryomech Helium Recovery Systems enable laboratories to manage their helium consumption and conservation, providing large-scale helium recovery.

- Atmospheric Recovery Bags sized to match your boil-off rates, transfer speeds and space
- Stand not included
- Variety of options for helium gas storage, including a medium pressure compressor with higher flow rate or high pressure compressor with condensed storage options
- Options for purification:
 - Low-cost nitrogen cold trap technology
 - Automatic cryogen-free technology
- Scaled and designed to match the liquefaction rate of the Cryomech Liquid Helium Plant
- Cryomech provides all helium connections from recovery bag to liquefier



Comparison

Medium Pressure Recovery

- Recovery rate of 8.5 SCFM or ~20 liquid liters per hour
- Medium pressure (400 PSIG) storage tanks that hold ~16 liquid liters

High Pressure Recovery

- Recovery rate of 5.1 SCFM or ~10 liquid liters per hour
- High pressure (2400 PSIG) storage tanks that hold ~10 liquid liters

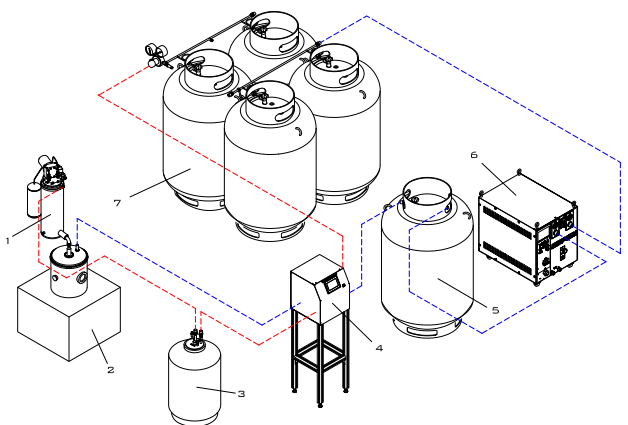
Compact Recovery System

The Compact Recovery System is a cost-effective option for helium management, especially for low boil-off applications.

Closed-cycle helium recovery has been historically elusive for users with extremely vibration-sensitive devices and limited space. Cryomech now offers a solution for both our Helium Reliquefiers and our Liquid Helium Plants that provides low volume gas storage only when you need it.

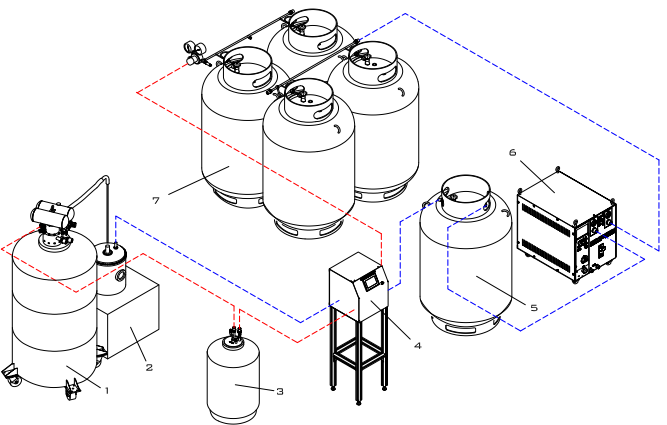
As opposed to our full-scale recovery system, this on-demand recovery is accomplished without the space-consuming recovery bag and external purifier. Not only is this straightforward recovery a better use of your facility space, it is more efficient both in terms of your helium management and your budget.

Potential applications for compact recovery are: STM, AFM, MEG, NMR, Flow Cryostats, and other vibration-sensitive applications.



1. Helium Reliquefier (HeRL)
2. Customer Cryostat
3. Purifier
4. Control Box
5. Buffer Volume
6. Recovery Compressor
7. Storage Cylinders

--- Recovery Mode
--- Liquefy Mode



1. Liquid Helium Plant (LHeP)
2. Customer Cryostat
3. Purifier
4. Control Box
5. Buffer Volume
6. Recovery Compressor
7. Storage Cylinders

--- Recovery Mode
--- Liquefy Mode

Cold Helium Circulation Systems

Cold Helium Circulation Systems

Cryomech Cold Helium Circulation Systems (CHCS) are the perfect solution for remotely cooling the most vibration-sensitive applications.



Read more about our Cold Helium Circulation Systems on [Bluefors.com](https://bluefors.com)



Cold Helium Circulation Systems

Vibration-sensitive applications can be cryocooled in the 20-100 K range with Cryomech Cold Helium Circulation Systems.

The systems utilize Gifford-McMahon Cryocoolers that are separated from the cooled application by Cold Helium Transfer Lines. This makes the systems reliable and ideal for vibration-sensitive applications.

We offer closed-loop systems which utilize a cold finger for sample mounting, and an open-loop system for pre-cooling low temperature superconducting magnets.



Product Highlights

✓ **Reliability with Cryomech Cryocoolers**

The complete system is closed-cycle, and operates with the reliability of the GM Cryocoolers and a warranty of 10 000 hours. The Cold Helium Circulation System uses the AL600 GM Cryocooler.

✓ **CHCS for Magnet Pre-Cooling**

Cold Helium Circulation Systems can be used for pre-cooling superconducting magnets from room temperature to ~30 K.

✓ **No More LN2 Pre-Cooling**

Designed to reduce liquid helium bath contamination with no need for liquid nitrogen pre-cooling.

✓ **Helium Circulation Flow Rate**

The helium circulation flow rate is ~3.3 g/s at 2 bar absolute pressure.

Closed-Loop CHCS Systems

With the closed-loop CHCS systems, the customer’s object is cooled by mounting it to a cold finger through which circulating, constant-pressure, cold helium flows to absorb the heat load.

The cold helium is cryocooled by a Gifford-McMahon Cycle Cryocooler separated from the cold finger by the flexible Cold Helium Transfer Line, eliminating vibrations. The CHCS comes in two capacity sizes: the 120W CHCS120, and the 200W @ 80 K CHCS200.

For customers experienced with open-cycle flow Cryostats, the CHCS is essentially a cryocooled open-flow Cryostat-type system. When the open end of the flowing cold cryogen has been closed off and re-pumped, re-cryocooled and re-circulated, no cryogens are needed.

Inside the vacuum chamber assembly, the cold head of the AL Series Cryocooler interfaces with the circulating cold helium. It is here that the heat load added to the cold finger is pumped out of the CHCS. The compressor package, the cold head, two flexible lines and motor cord make up the components of the Gifford-McMahon Cycle Cryocooler.

Open-Loop CHCS Systems

The open-loop MPC600 CHCS System can provide remote and distributed cooling to a cryostat via helium gas.

Helium gas is cooled with a Gifford-McMahon Cryocooler and circulated with a cryogenic circulator or “Cryofan.” The system connects to the cryostat via two flexible Cold Helium Transfer Lines with bayonet fittings, allowing the heat exchanger to be designed and integrated into the cryostat based on the application requirements.

Based on our CHCS technology, the MPC600 is a mobile cooling system for pre-cooling low temperature superconducting magnets (such as MRI magnets) from room temperature to 30 K using helium gas. All components are contained on a mobile dolly, and it only requires a high-pressure helium gas cylinder, power, and cooling water to operate.



Liquid Nitrogen Plants

With Cryomech Liquid Nitrogen Plants, you only need to supply power and air to produce liquid nitrogen anywhere in the world.



Read more about our
Liquid Nitrogen Plants
on Bluefors.com



Access Liquid Nitrogen Anywhere in the World

Cryomech Liquid Nitrogen Plants center their robust and versatile design on the principles of the Gifford-McMahon Cryocooler.

The modular system can be purchased with the filter bank nitrogen generator if a purity ≥ 98 percent is required. At a small scale, the system is designed to be mobile and fit into most user locations, regardless of space or environmental restrictions.



Product Highlights

✓ **Produce 10-240 Liters/Day**

10-240 liters of liquid nitrogen can be produced per day directly from the air using advanced membrane technology.

✓ **Reliable, Automatic and Safe**

Cryomech Liquid Nitrogen Plants can operate 24 hours a day, 7 days a week reliably, automatically, and safely.

✓ **Easy Maintenance**

Most maintenance can be performed in the field with minimal technical training. If necessary, technical training is offered at our facility in Syracuse, New York.

✓ **Solutions for Different User Needs**

Our Liquid Nitrogen Plants are in operation all over the world, and they are designed to suit different user locations.

✓ **Low-Loss Liquid Nitrogen Transfer**

Cryogenically insulated extraction line and valve for low-loss liquid nitrogen transfer.

✓ **Automatic Level Indicator**

Automatic level indicator initiates standby mode when Dewar is full.

Liquid Nitrogen Plants Comparison

	LNP10	LNP20	LNP40	LNP60	LNP120	LNP240
Power Consumption (Input Power) – Water Cooled	3.3 kW @ 60Hz 3.0 kW @ 50Hz	3.9 kW @ 60Hz 3.3 kW @ 50Hz	5.1 kW @ 60 Hz 4.2 kW @ 50 Hz	7.5 kW @ 60Hz 7.0 kW @ 50Hz	12.5 kW @ 60Hz 11.5 kW @ 50Hz	12.5 kW @ 60Hz (x2) 11.5 kW @ 50Hz (x2)
Power Consumption (Input Power) – Air Cooled	3.5 kW @ 60Hz 3.2 kW @ 50Hz	4.1 kW @ 60Hz 3.5 kW @ 50Hz	5.7 kW @ 60 Hz 4.8 kW @ 50 Hz	8.1 kW @ 60Hz 7.6 kW @ 50Hz	N/A	N/A
Cryocooler Model	AL60	AL125	AL200	AL300	AL600	AL600 (2)
Dewar Capacity	35 L	100 L	160 L	21 L	300 L	500 L
Production Rate	10 L/Day	20 L/Day	40 L/Day	60 L/Day	120 L/Day	240 L/Day
Nitrogen Purity	98%	98%	98%	98%	98%	98%
Compressed Air Requirement	48 ALPM @ 6 bar FAD	105 ALPM @ 6 bar FAD	144 ALPM @ 6 bar FAD	224 ALPM @ 6 bar FAD	442 ALPM @ 6 bar FAD	665 ALPM @ 6 bar FAD
Helium Compressor Model	CP103 Air or Water Cooled	CP103 Air or Water Cooled	CPA2850 Air or Water Cooled	CPA2870 Air or Water Cooled	CPA1114 Water Cooled Only	CPA1114 (2) Water Cooled only
Available Electrical Options	208/230 VAC; 1 Phase; 60 Hz 200VAC; 1 Phase; 50 Hz	208/230VAC; 1 Phase; 60 Hz 200VAC; 1 Phase; 50 Hz	200/230VAC; 3 Phase; 60 Hz 440/480VAC; 3 Phase; 60 Hz 200VAC; 3 Phase; 50 Hz 380/415VAC; 3 Phase; 50 Hz	200/230VAC; 3 Phase; 60 Hz 440/480VAC; 3 Phase; 60 Hz 200VAC; 3 Phase; 50 Hz 380/415VAC; 3 Phase; 50 Hz	440/480VAC; 3 Phase; 60 Hz 380/415VAC; 3 Phase; 50 Hz	440/480VAC; 3 Phase; 60 Hz 380/415VAC; 3 Phase; 50 Hz



°BLUEFORS

Bluefors operates in a world of cold. We offer reliable, industry-leading cryogenic measurement systems, cryocoolers and ground-breaking cryogenic products that allow physicists and scientists to consistently work at cryogenic temperatures.

Cool for Progress.

Contact Sales



Ready to hear more?
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