Quantum Optics

µDrift Cryostat

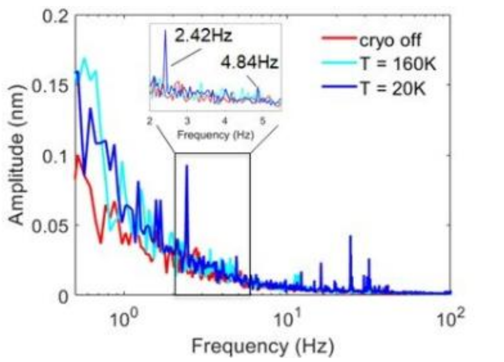
Technical Datasheet

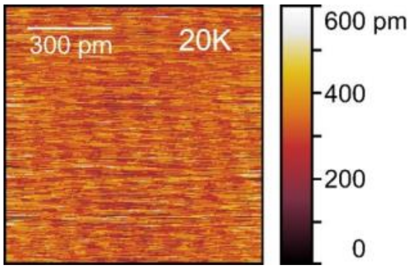
Experience the next generation of modular cryogenics with unparalleled sample stability.

Application Notes

Atomic Force Microscopy

University of Colorado

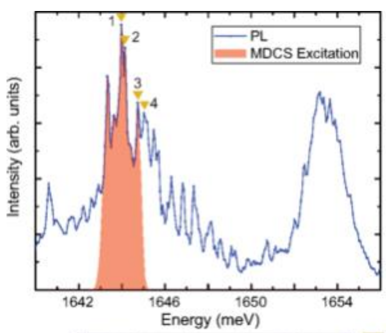


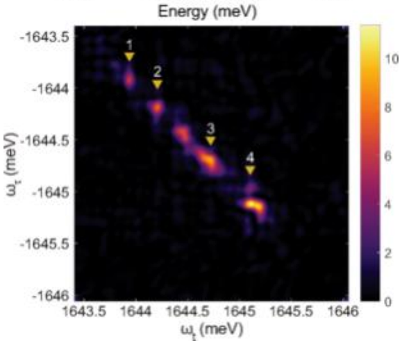


Performance characteristics recorded with an AFM operating in tapping mode while cooled by an ARS ultra low vibration cryostat are shown.
The top shows the z-noise spectrum in the AFM tip-sample junction at different temperatures, demonstrating that the vibrations of the cryocooler have little effect on the AFM, contributing only negligible noise at very low temperatures.
The bottom shows the scanning noise performance at 20K, demonstrating RMS noise of 100-150pm, noise levels comparable with state of the art ambient condition tapping mode AFMs. The image shows raw data – with a Fourier filter the periodic ripples in the image can easily be removed in post-processing. However, due to their low amplitude, the ripples would not be observable against the sample topography in most samples, even samples only exhibiting monolayer step edges.

Quantum Dots

University of Michigan





Shown here are data collected from a sample inside an ARS ultra-low vibration cryostat.
Photoluminescence (PL) excited by a 633 nm laser is measured on a spectrometer with 100μeV resolution. Features below 1650 meV are attributed to localized quantum dot states that we spatially isolated with a diffraction-limited 700 nm spot.
The wide feature above 1650 meV is the residual two-dimensional (quantum-well) states. The region measured by multidimensional coherent spectroscopy (MDCS) in this paper, shaded in red, is determined by the shaped laser spectrum we use. Bottom: single-quantum MDCS spectrum of the same region allows for comparison of the oscillator strengths of resonances and reveals that some of the weakly excited higher-energy states have very high oscillator strengths.

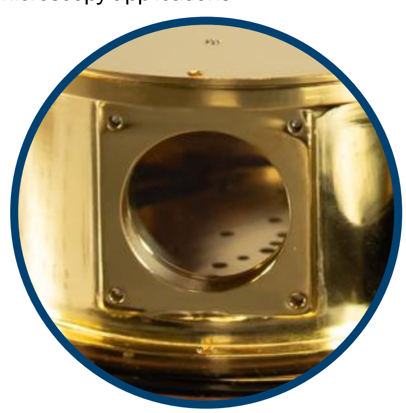
Optical Access

Low-Working Distance Axial Window
The top window is designed for access by high powered optics with close access to the sample

Radial Windows
Four Ø1.50” clearview window ports surround the sample plate.

Re-Entrant/Recessed Windows
Re-entrant windows allow a working distance as low as 11 mm from outside of any of the radial window ports.

In-Vacuum & Cold Objectives
Often paired with nanopositioners, in-chamber objectives provide the ultimate low-working distance for confocal microscopy applications.



Cold Windows
Add another layer of protection from blackbody radiation to maintain low temperature performance with multiple windows open.

Axial Window

Window Clearview	0.90” [23 mm]
Window Material	1 mm Quartz or 0.5 mm Sapphire
Minimum Working Distance	7mm

Radial Windows

Number of Window Ports	Four
Window Clearview	Ø1.50” [38 mm]
Working Distance	1.00” [25 mm]
Beam Height	4.50” [114 mm]
Acceptance Angle	42°

Features

Base Temperature

3.8 K

Cooldown Time

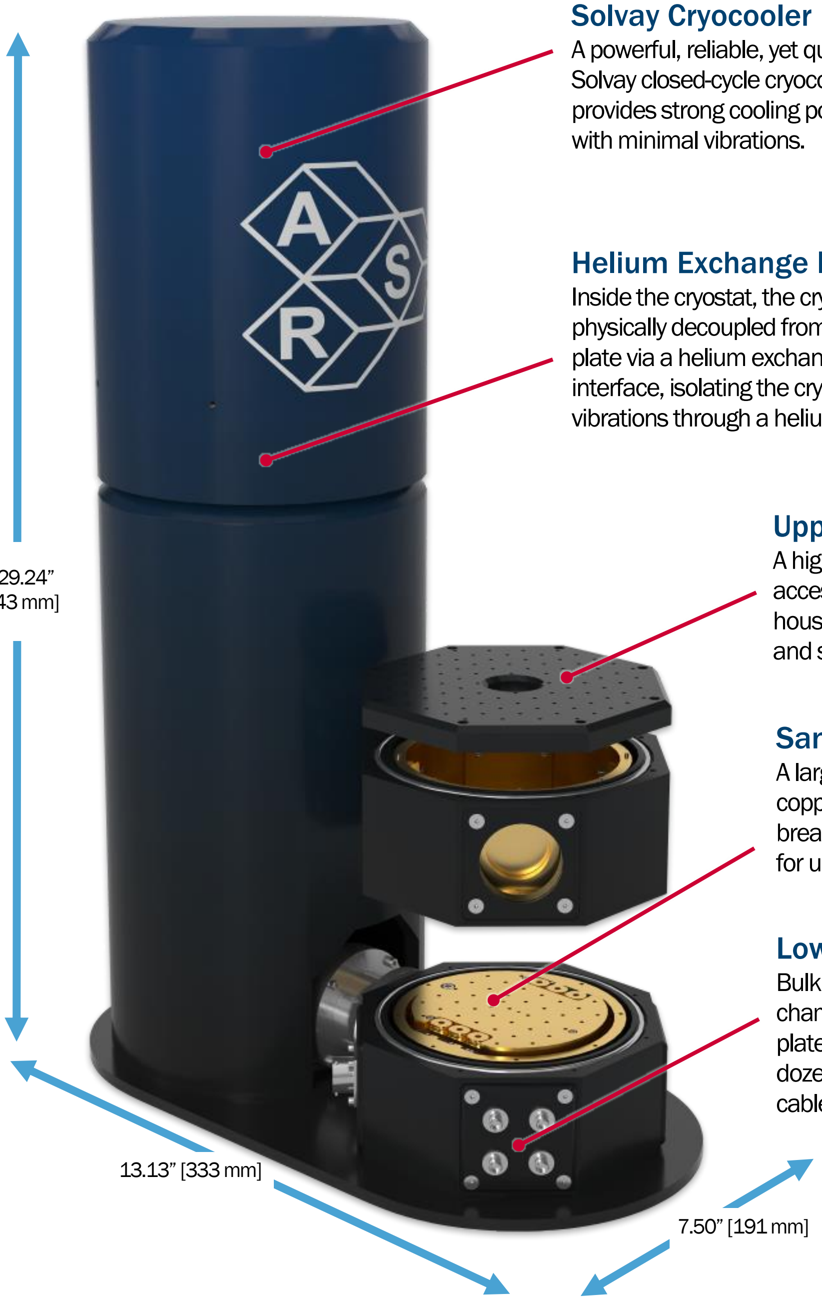
4 hr

Vibration

10 nm

Drift per hour

100 nm



Solvay Cryocooler

A powerful, reliable, yet quiet Solvay closed-cycle cryocooler provides strong cooling power with minimal vibrations.

Helium Exchange Interface

Inside the cryostat, the cryocooler is physically decoupled from the sample plate via a helium exchange gas interface, isolating the cryocooler’s vibrations through a helium chamber.

Upper Chamber

A highly modular and accessible optical block houses the radiation shield and sample plate in vacuum.

Sample Plate

A large gold-plated OFHC copper sample plate features a breadboard mounting pattern for ultimate mounting flexibility.

Lower Chamber

Bulkheads surround the lower chamber beneath the sample plate, allowing access with dozens of DC wires and RF cables.

Upper Chamber

Sample Plate Diameter	Ø4.00 in [Ø100 mm]
Maximum Sample Height	2.00 in [51 mm]
Sample Plate Mounting	#4-40 or M4 Breadboard
Sample Plate Material	OFHC Copper, Gold-Plated

Lower Chamber

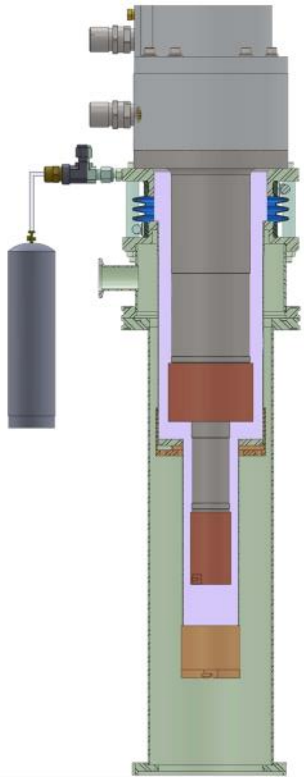
Number of Bulkheads	Four
RF Connections per Bulkhead	Up to five each (SMA or BNC)
DC Connections per Bulkhead	Up to 32 each
Fiber Optic Ports	Up to two each (SMA or FCP)

Vibrations and Drift

Stability at the Nanometer Scale

Modern nanoscience applications are increasingly demanding of sample stability at low temperature.

To meet this need, ARS has continued to develop vibration reduction technologies.



Helium Exchange Decoupling

As the largest contributor of vibrations, the cryocooler is physically decoupled from the sample space, convectively cooling it via a highly -efficient heat exchanger. This method results in the following benefits:

☑ Nanometer scale vibrations at the sample mount

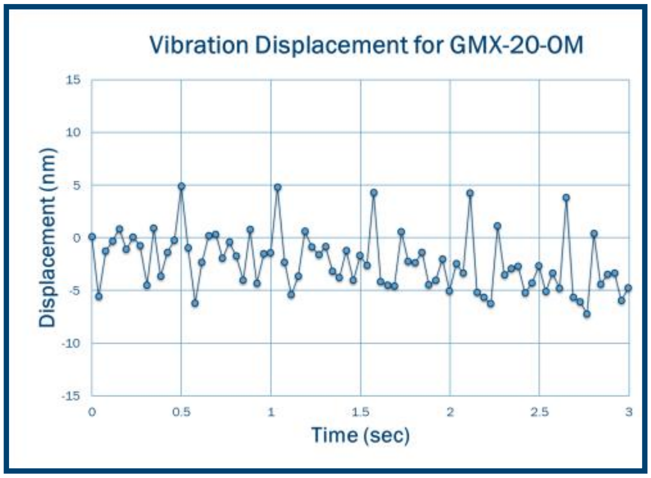
☑ Cryocooler vibrations directed away from the experiment entirely

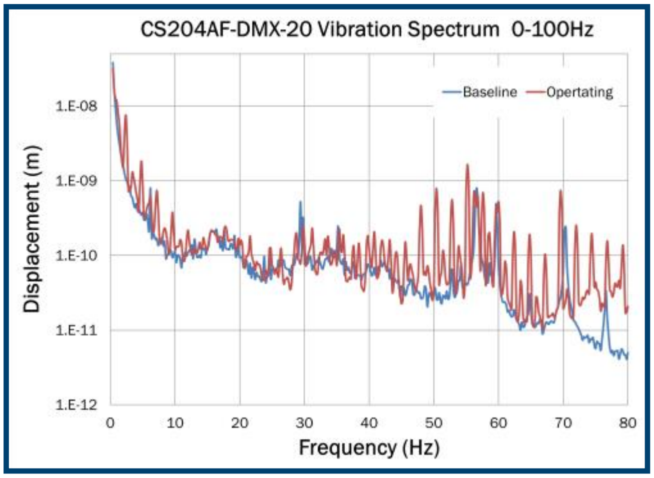
☑ No need for expensive and scarce liquid helium

Field-Proven Results

Over decades, hundreds of researchers have designed their experiments around ARS nanoscience systems, ranging from Scanning Probe microscopy techniques to ion traps. In real-world conditions, scientists have reported sample vibrations as low as 3 nanometers

Model	GMX-20-μDrift
Vibration Amplitude, In-Plane *Peak-to-peak*	5 nm
Vibration Amplitude, Out-of-Plane *Peak-to-peak*	10 nm
Drift per hour, Out-of-plane *With ambient temperature variation < 0.04 K*	100 nm
Drift per 24-hours, Out-of-plane *With ambient temperature variation < 1.0 K*	750 nm
Drift during 4K to 50K sweep	300 nm

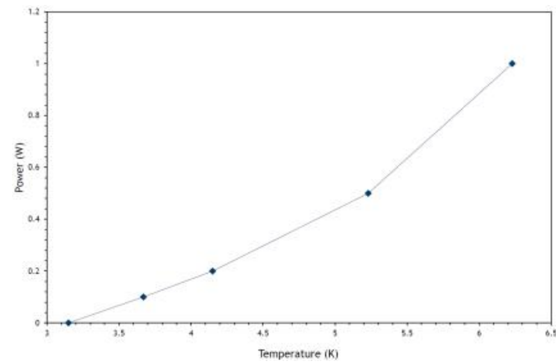




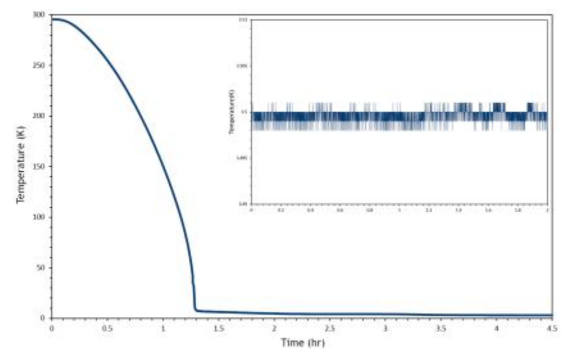
Temperature

Cryogenic Performance

Model	GMX-20-μDrift
Sample Plate Base Temperature *Measured without heat loads*	< 3.80 K
Temperature Stability	± 0.01 mK
Cooldown Time to Base Temperature	280 min
Cooling Power	0.5 Watts at 5 K
Sample Plate Maximum Temperature	450 K



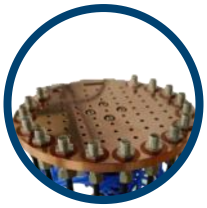
Cryocooling Technology	Pneumatic Gifford-McMahon (Solvay)
Temperature Control	PID Feedback
Feedback Loop #1	Heater and Sensor at Interface Cold Tip
Feedback Loop #2	Heater and Sensor at Sample Plate



Accessories

Nanopositioning

Masterfully integrated with the cryogenic platform, nanopositioners grant sample rotation and motion in XYZ with nanometer precision.

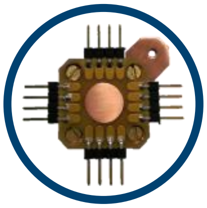


DC and RF Cabling

Access the sample electrically to frequencies up to 24 GHz with wires and cables pre-thermalized by cryogenic experts.

Support Stands

To eliminate momentum transfer to the floor, the cryocooler is supported from a separate structure than the cryostat such as our standard floor stand.



Sample Holders

Browse our standard selection of sample holders, or work with a cryogenics engineer to design a custom one.

Fiber Optics

Introduce light through a singlemode or multimode fiber, pre-built into the cryostat.

Vacuum Pumping

Choose a high-quality vacuum pump for a fast pumpdown and clean sample environment.