



Visit attoCRYO online

attoDRY800

Cryo-Optical Table

© 2015, attocube systems AG - Germany. attocube systems and the logo are trademarks of attocube systems AG. Registered and/or otherwise protected in various countries where attocube systems products are sold or distributed. Other brands and names are the property of their respective owners.

attocube systems AG | Königinstrasse 11a | D - 80539 München | Germany
Tel.: +49 89 2877 809 - 0 | Fax: +49 89 2877 809 - 19 | info@attocube.com
www.attocube.com

Brochure version: 2015 - 02

attoDRY800

cryo-optical table (closed-cycle)

Specifications

attoDRY800

Quantum optics experiments often require cryogenic temperatures in combination with optical access to the sample space. Most experimental setups contain numerous optical elements that need to be precisely arranged on an optical table to shape and prepare the incident light, as well as to efficiently collect and convert the emitted light from the sample. The available space on the optical table in such cases is of paramount importance to many complex setups.

The revolutionary concept and design of the attoDRY800 presents the perfect solution to satisfy these demanding requirements: it consists of an ultra-low vibration cold breadboard platform which is fully integrated into an optical table. The cryocooler assembly is located in the otherwise unused space underneath. This unique design ensures a free workspace and unobstructed optical access to the cold sample from all directions on the optical table via 4 side and 1 top window. Apochromatic objectives with high numerical aperture (NA=0.81-0.95) can either be integrated into the cryostat, into the vacuum shield, or put in close working distance next to the optical windows from the outside. This ensures extremely low drifts and optimal collection efficiency.

Being a closed-cycle cryostat, the attoDRY800 is the perfect replacement for all helium flow cryostat setups, adding the huge advantage that it requires no liquid cryogenics and thus minimizing running costs. In addition, a fully automated temperature control between 3.8 and 320 K conveniently enables unattended long measurement cycles.

While most other off-the-shelf closed-cycle cryostats suffer from severe vibrations at the sample location, during the development process of the attoDRY800 special attention was given to keep the vibration level via a patented vibration isolation technology smaller than 1 nm (RMS). Hence, with the attoDRY800 even extremely sensitive measurements are possible. Its cold breadboard sample space is designed to host several of attocube's patented nanopositioners, as well as complete microscope or photonic probe station solutions.

PRODUCT KEY FEATURES

- cold breadboard integrated into optical table
- low vibrations < 10 nm peak-to-peak
- fully automated variable temperature 3.8 .. 320 K
- customizable vacuum shroud

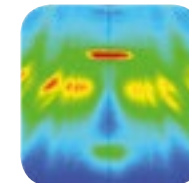
BENEFITS

- free workspace & obstruction-free optical access
- high sample throughput due to fast cooldown
- low running costs (no liquid cryogenics)
- flexible combination with attocube equipment: patented cryogenic positioning solutions with multi-degrees of freedom

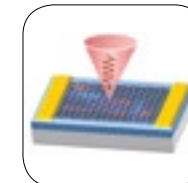
APPLICATION EXAMPLES

- quantum dot spectroscopy
- photocurrent / photoconductivity
- time-resolved spectroscopy
- reflectance / transmittance measurements
- micro-Raman imaging & spectroscopy
- optical resonators coupled to waveguides
- plasmonics on 2D materials
- resonant fluorescence
- optically detected nuclear magnetic resonance
- quantum information processing
- scanning probe microscopy

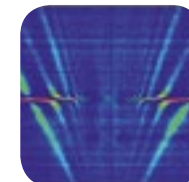
Application examples



Quantum Dot Spectroscopy



Photocurrent / Photoconductivity Measurements



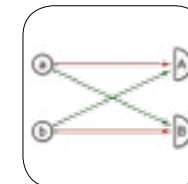
Micro-Raman Imaging / Spectroscopy



Optically Detected Nuclear Magnetic Resonance



Resonant Fluorescence



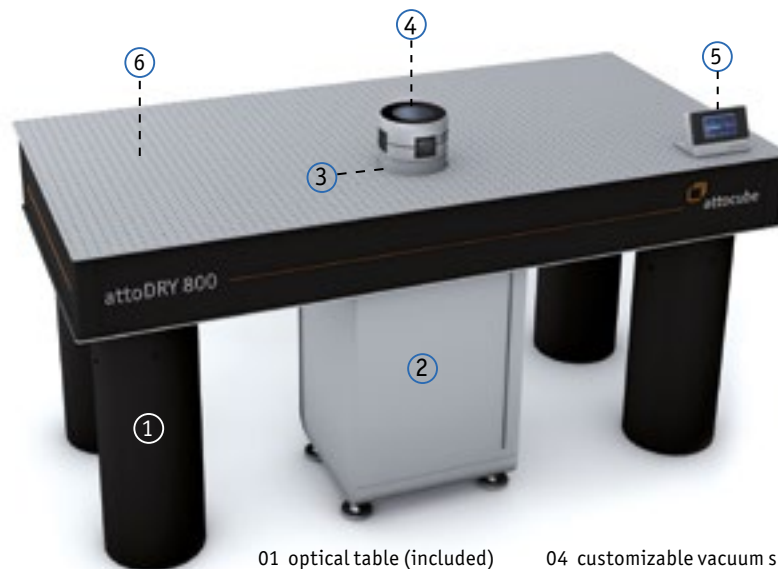
Quantum Information Processing



- **Obstruction free** work space
- **Optical table included** (different sizes available)
- 29 customer wires included, **heat sunk @ 4 K**
- Touchscreen based control interface, **no PC required**

General Specifications	
technology	ultra-low vibration, closed-cycle cryostat intimately integrated into optical table, optical table included (water or air-cooled compressor available)
sample environment	cryogenic vacuum, sample cooled via braids (ATC100)
sample space	75 mm (diameter)
sample exchange	easy access via removal of vacuum shroud
vibration & acoustic noise damping system	proprietary low vibration design
usability	obstruction free work space, touchscreen based control interface, no PC required, fully automated temperature control (vacuum, cooldown, T control, warmup)
Performance Data*	
temperature range	3.8 .. 320 K
cooldown time to 6 K (4 K)	approx. 3 h (4-5 h), depending on load
temperature stability	15 mK (peak-to-peak with damped sample mount)
vibration level	< 10 nm (peak-to-peak)
cooling power at sample location	100 mW @ 4.2 K
Closed-cycle cooler	
power consumption	max. 3 kW
cooling of compressor	water cooling (default; requires local infrastructure) air cooling (optional)
Dimensions	
Optical table	standard size 900 mm x 1800 mm x 305 mm (leg height 597 mm); metric or imperial mounting threads (other table sizes available)
Options	
temperature controller	included
pumping kit	included
electrical access	29 customer wires included, heat sunk @ 4 K (additional wiring on request)
optical windows	4 side windows, 1 top window (1" diameter) up to 9 windows possible (optional)
type of windows	BK7 (others on request)
UHV version	on request
larger sample space	on request (200 mm)
vacuum shroud	customized height and diameter (on request)
feedthroughs	electrical (DC, HF), optical fibers, gas capillary (on request)
sample motion	Preimum Line positioners and scanners

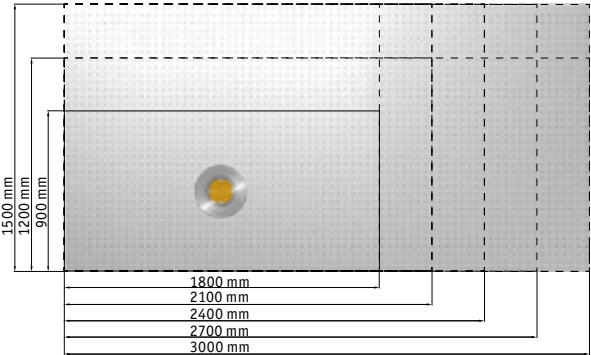
*Note: All product specifications are based on a standard system. Optional items or upgrades, other configurations or customization may change one or several of the indicated values. Specifications and other information subject to change without notice.



- 01 optical table (included)
- 02 cryocooler
- 03 cold breadboard
- 04 customizable vacuum shroud with 5 windows (1")
- 05 touchscreen user interface
- 06 obstruction free work space

attoDRY800 Options

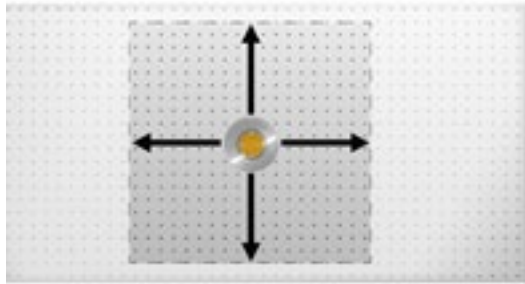
optional items for the cryo-optical table



Decide on the table size

Customized Newport optical tables with metric M6 or imperial hole pattern are available with the following dimensions:

Default size: 900 mm x 1800 mm Leg height: 597 mm, Table thickness: 305 mm	
1200 mm x 1800 mm	1500 x 1800 mm
1200 mm x 2100 mm	1500 x 2100 mm
1200 mm x 2400 mm	1500 x 2400 mm
1200 mm x 2700 mm	1500 x 2700 mm
1200 mm x 3000 mm	1500 x 3000 mm



Choose location of cold breadboard

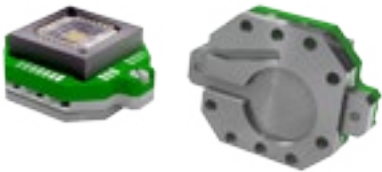
In order to optimally adapt the system to specific experimental needs, the location of the cold plate of the cryostat can be specified by the customer upon ordering. It can be placed as close as 200 mm to the long edge, as well as off-center with respect to the short edge on wider tables (depending on table size).

Contact attocube for more details.



Add multiple degrees of freedom for sample motion

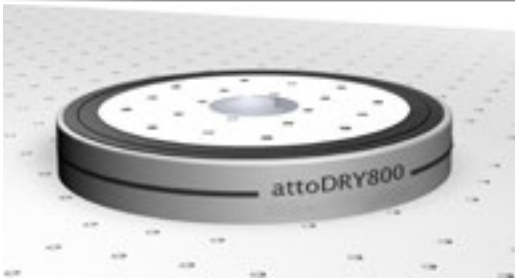
The attoDRY800 is predestined to host your choice of nanopositioners, be it linear, rotary, tilting or scanning stages. Combine many degrees of freedom, or more than one stack of positioners to fulfill all requirements of your application! With our dedicated ATC100 thermal link, we ensure a perfect thermalization of your sample that is straightforward to mount and easy to use.



Sample holder (ASH/LCCC)

For users that require a sample holder with electrical contacts, attocube offers a chip carrier socket for standard 20, 28 or 32 pin leadless ceramic chip carriers. The replaceable PCB base features conveniently accessible contacts for the wiring. Good thermal contact is ensured via a Cu post which extends all the way through the assembly from the thermal link (ATC100) to the leadless ceramic chip carrier. Precise temperature control is achieved via an additional calibrated temperature sensor and heater integrated into the sample holder base.

Article	
ASH/LCCC/20	No: 1010435
ASH/LCCC/28	No: 1010436
ASH/LCCC/32	No: 1010437



Ultra-low working distance – replace your flow cryostat!

A popular option for flow cryostats is to bring the cold sample as close as possible to an ultra-low working distance window. This allows to flexibly use external optics with a very high angle of admittance, maximizing the collection efficiency via high numerical aperture objectives. The ultra-low working distance option (ULWD) is available with a fixed sample holder, or ready to host either XY or XYZ positioners respectively.

Specifications	
minimum working distance (without cold window)	1 mm
minimum working distance (with cold window)	2 mm
window material	fused silica (others on request)
window thickness	0.5 mm
clear aperture outer window	10 mm



Electrical and optical feedthrough options

Additional optional wiring is either provided upon ordering directly through the cryostat, with convenient electrical access at pin connectors close to the sample in vacuum for customer use, or pre-wired and interfaced directly to the cold plate. Retrofit extra wiring or optical feedthroughs are possible via electrical feedthroughs in an adapter ring at the bottom of the sample chamber.

Article	
Electrical access in vacuum	10, 25 or 41 wires, terminated in vacuum
Pre-wired to cold plate	10, 25 or 41 wires, low resistance, compatible with nanopositioners
Coaxial feedthroughs	2 or 4 SMA connectors
Fiber feedthroughs	1, 2 or 4 FC/APC or FC/PC connectors

attoDRY800 Optical Cryo-Microscope

integrated apochromatic low temperature optics for maximum collection efficiency

When collecting small optical signals, e.g. from single photon emitters, which constitute promising candidates for solidstate based qubits, it is a crucial requirement to maximize the collection efficiency. This is best done with objectives that feature high numerical apertures, which usually implies a low working distance. In this case getting the objective close to the specimen is necessary. Most high quality optics are designed for room temperature use, which would not survive periodic thermal cycling. Putting an objective outside of a cryostat often results in large drifts, which are unacceptable for the long measurement cycles required when focusing on a single quantum emitter.

The solution is provided by the attoDRY800 optical cryo-microscope: based on the unique low vibration design of the attoDRY800 cryo-optical table, it features a fully integrated cold objective, hence minimizing drift while maximizing the collection efficiency. The apochromatic objective is located in cryogenic vacuum in close proximity to the sample. Aside from the high numerical apertures ranging from 0.81-0.82 of the objective, their biggest advantage is their small chromatic shift. Optimized for working ranges of 465-600 nm, 565-770 nm and 700-985 nm respectively, the LT-APO objectives keep the focal plane within one depth of focus ($\sim 1 \mu\text{m}$), ensure a uniform spot size, and an intensity of emitters which stays within 75-100%.

vacuum shroud with 5 optical windows



low temperature compatible apochromatic objective

radiation shield



nanopositioner stack (x,y,z) with thermal flex link

cold plate

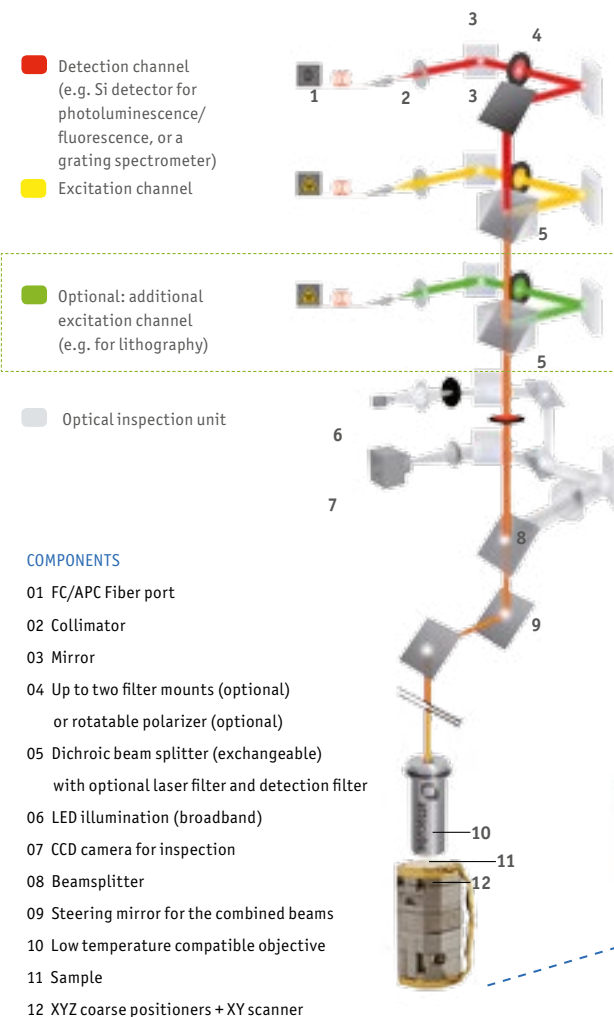


attoCFM/800

complete cryogenic confocal microscope

For many years, attocube has been pioneering cryogenic confocal microscopy. With the introduction of the attoCFM series of confocal microscopes almost a decade ago, the optical investigation of single quantum devices on the sub-micron scale at low temperature suddenly became available as a standard tool for scientists worldwide. Today, the attoCFM/800 is once again redefining the state-of-the-art for low temperature confocal microscopy.

It combines the revolutionary concept of the world's first cryo-optical table with integrated low temperature objectives and the external optics head of the attoCFM I. The researcher is provided with a complete cryogenic confocal microscope system which arrives in his laboratory fully integrated and tested. Accompanied by an on-site installation and hands-on training by our experienced optics experts, this will jump start your measurements, and enable useful research results in a minimum amount of time. F



Cryogenic apochromatic objectives

- negligible chromatic focal shift in working range
- uniform spot size and intensity within apochromatic range

