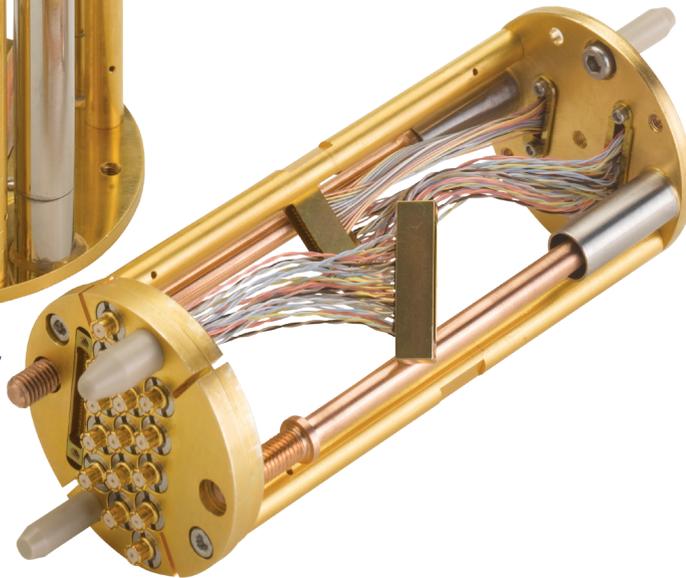


Rapid Sample Exchange

Patented[‡] bottom loading sample mechanism for cryogen free dilution refrigerators



‡ Patent No. EP 2742299,
WO 2010/106309



- Proven 10 mK sample temperatures
- Supports a wide range of wiring configurations
- Puck sizes to suit magnet bore
- 40 GHz SMP type low insertion loss RF connectors
- 50 way sub-nano low noise DC connectors
- Low eddy current design
- Rapid thermal cycling
- Sample protected from ESD
- Make before break interfacing
- Piezo nano-positioning stage compatible
- Suitable for free-space optics

Sample loading

Cryofree dilution refrigerators have a large available sample volume at various temperatures throughout the system. With the large plate diameters comes an increase in the surface area available for the heat sinking of experimental services as well as, with no LHe bath to impede, sample access from below.

Demountable electrical connections allow the sample puck to interface with experimental services installed directly onto the dilution refrigerator, allowing more complex wiring that due to space constraints is not feasible on a sample probe.

A vacuum port is located on the underside of the system, with the docking station positioned within the bore of the magnet. In this configuration, the sample puck diameter is governed by the diameter of the magnet bore. With a short working distance to the field centre overall system height is minimised.

Make before break and ESD Protection

With ever more sensitive nano-devices of interest to the research community so greater ESD protection is required when handling and during sample exchange.

The sample pucks and loaders are designed with connectors and wiring from both ends of the sample puck to enable bias and grounding of the device and the mating electrical connections through the fridge. By ensuring all pin potentials are uniform sensitive devices are ESD protected during loading.

Furthermore, the mating connections to the fridge are made before the loading arm is removed ensuring 'make before break' is always achieved.

Once removed the loading arm can be removed completely ensuring no unwanted vibration or pendulum action from heavy components left in situ.





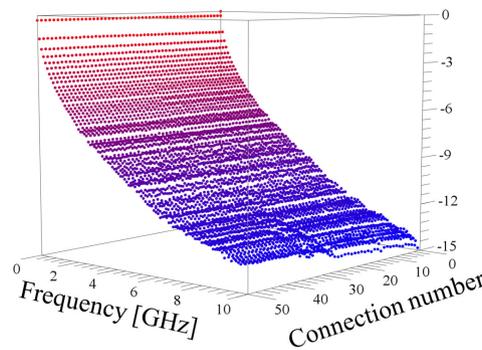
Puck Size	42 mm	60 mm	72 mm	72E mm	240 mm
RF Connectors	14	14	14	28	240
DC connectors	50	50	50	100	200
Magnet Bore	57 mm	77 mm	90 mm	90 mm	-
Sample Volume	25 mm	40 mm	50 mm	50 mm	200 mm
Cooldown time	10-12 hrs	12-14 hrs	12-16 hrs	12-16 hrs	48 hrs



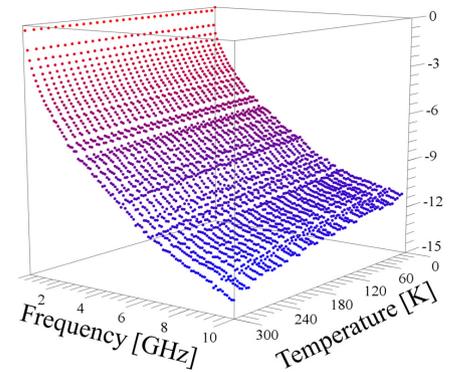
42 mm bottom loading puck interface

42 mm Bottom Loading Puck

- 14 off 40 GHz SMP type low insertion loss RF connectors
- 1 off 50 way sub-nano low noise DC connectors
- Low eddy current design
- Designed to suit 57 mm cold bore integrated superconducting magnets
- Ultra-low insertion & removal vacuum forces



Round trip RF attenuation as a function of connector mating cycle number



Round trip RF attenuation as a function of connector temperature

Insertion losses and RF performance

The choice of connector is critical to an RF cable assembly, with particular care required when making low temperature demountable connections. SMP connectors have the advantage of being blind-mate, small diameter (3 mm) and rated for 40 GHz operation.

Published test results show excellent reliability over time, with repeated thermal cycling, as a function of temperature and frequency. Loading takes a matter of minutes and device characterisation can be initiated immediately following sample docking ensuring no wasted time for pre-cooling.

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