

High magnetic field nuclear magnetic resonance experimental station

High magnetic field nuclear magnetic resonance (NMR) experimental station consists of the all-superconducting magnet, the variable temperature insert (VTI), the dilution refrigerator (DR), the magnetic resonance measurement system, and the helium liquefier system. Our station is mainly used to study solid materials at low temperatures down to 20 mK and strong magnetic fields up to 26 T. Compared with the water-cooling resistive magnet, the energy consumption of the all-superconducting magnet is reduced by three orders of magnitude, while the magnetic field's spatial homogeneity and temporal stability are significantly improved. The all-superconducting magnet can work stably and continuously with the helium recovery system. At present, we will continue upgrading the system, which is expected to perform high-resolution NMR, magnetic resonance imaging, and high-pressure NMR soon.

Specification of high magnetic field NMR station

Parameters	Values
Maximum field	26 T
Homogeneity	12 ppm@1 cm ³ < 7 ppm@1 cm ³ (with room-temperature shim coil)
Field stability	< 10 ppm/h (7 hours after reaching setpoint) < 2.5 ppm/h (24 hours after reaching setpoint)
Stray field	< 5 Gauss @5 m
Bore diameter	50 mm
Sample space	30 mm (VTI) 27 mm (DR)
Temperature range	1.4 - 300 K (VTI) 0.02 - 1.2 K (DR)
Cooling power	400 μW@100 mK
NMR frequency range	0.5 - 1200 MHz

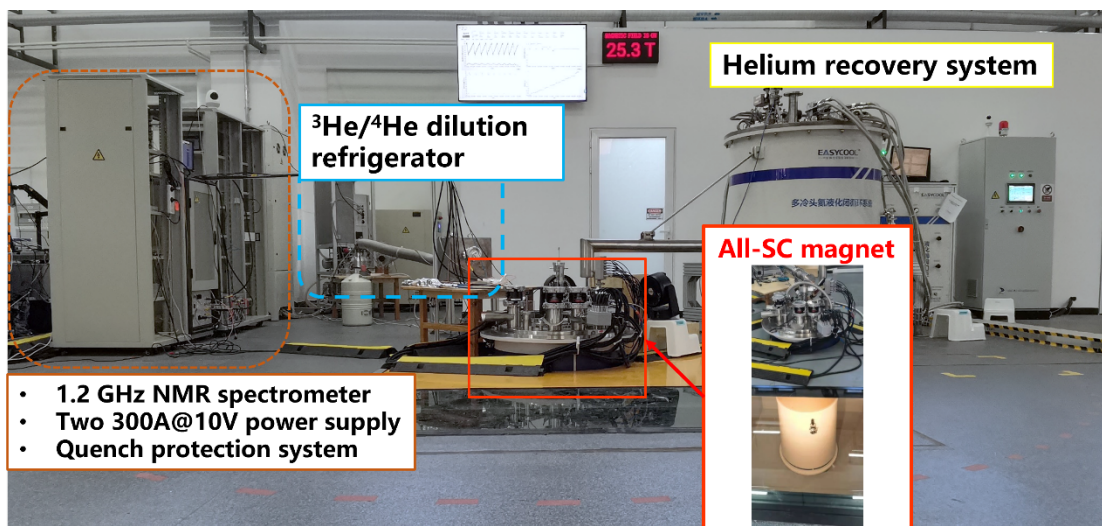


Photo of the experimental station

A detailed introduction to the nuclear magnetic resonance measurement system:

1. The NMR probe is homemade with two low-temperature coaxial cables, including accessories of a single-axis rotator and uniaxial strain device. The room temperature shim coil is also home-made and used in conjunction with a special NMR probe, with a sample space is only 15 mm.
2. The ^3He - ^4He mixing chamber of the DR is made of non-metallic material with a removable bottom cover. The sample is placed in the mixing chamber and directly touches the mixture. The DR includes 12 manganin twisted pairs wiring to the mixing chamber, 2 rigid coax cables with SMA connectors, and 1 rotating rod, available for both top-tuning and bottom-tuning.
3. Cooperating with other stations, we can also perform high-pressure NMR and transport measurements at a fixed magnetic field.

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