

Mini Cryogen-Free Magnet System

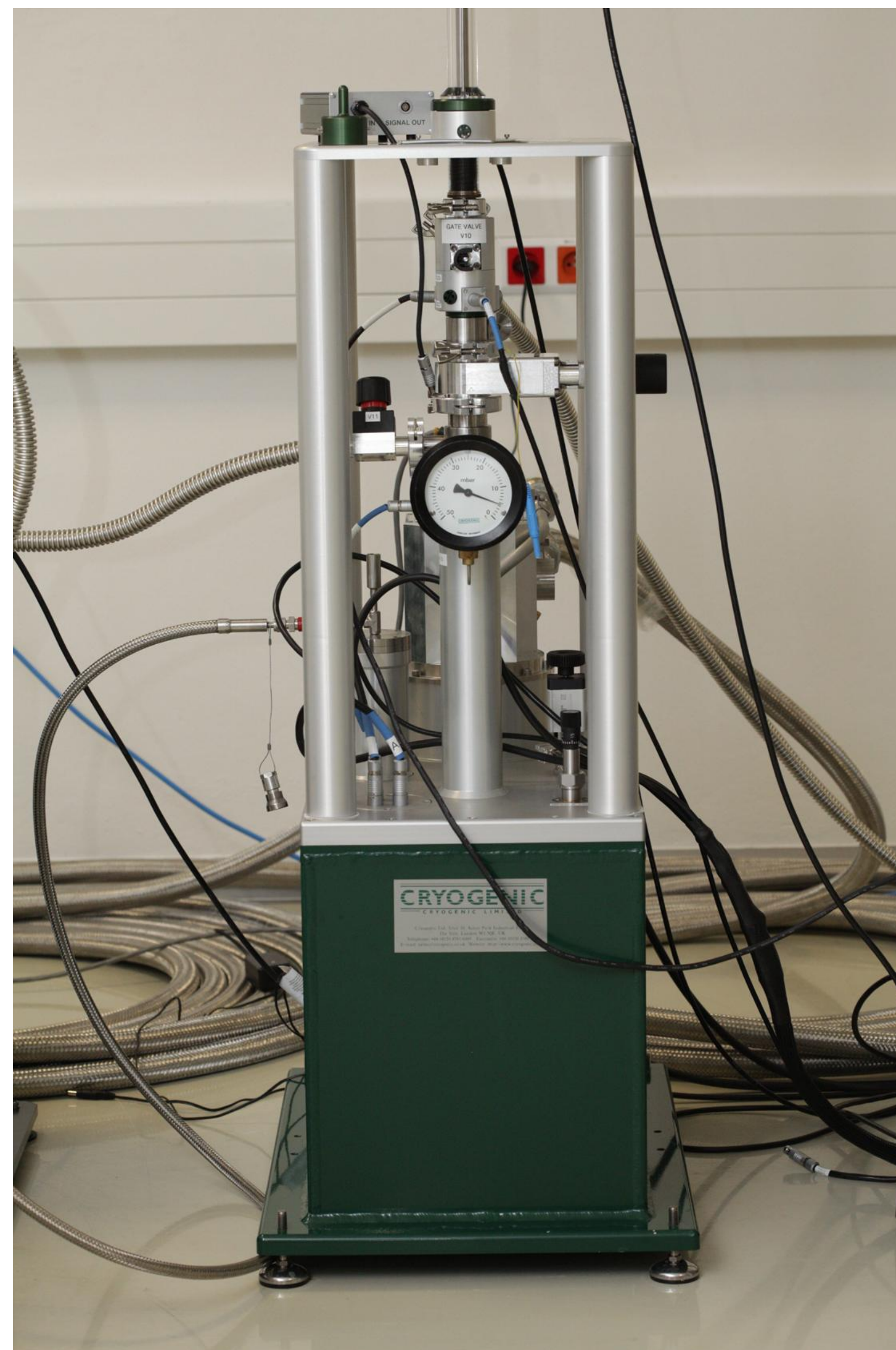
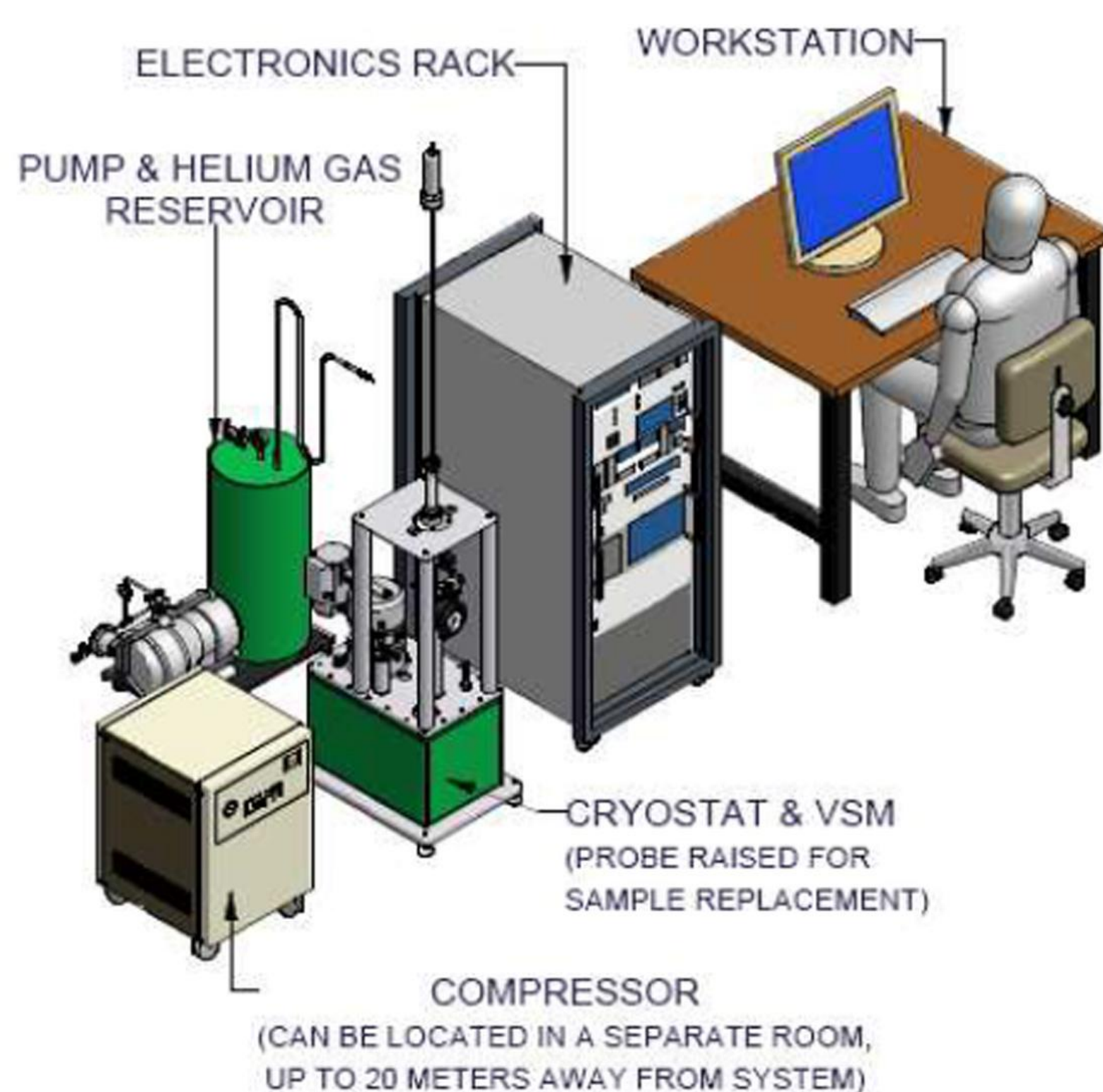
Introduction of mCFM System from Cryogenic Limited company

Mini Cryogen-Free Magnet System is a physical device used for production of strong magnetic field created by superconducting coil. The system combines the latest cryogen-free technology with sophisticated measurement techniques providing a versatile, powerful investigative device achieving low temperatures and high magnetic fields without the direct use of liquid helium or nitrogen. Closed loop system uses helium gas for refrigeration of the superconducting magnet and the sample. The instrument is designed for the measurement of magnetic properties using VSM (Moment and AC Susceptibility) and electrical properties (Resistivity and Hall effect). Measurement range is for magnetic field from -9 T to 9 T and for temperature from 1.6 K to 400 K .

Instrument setup

Instrument is comprised of the following components:

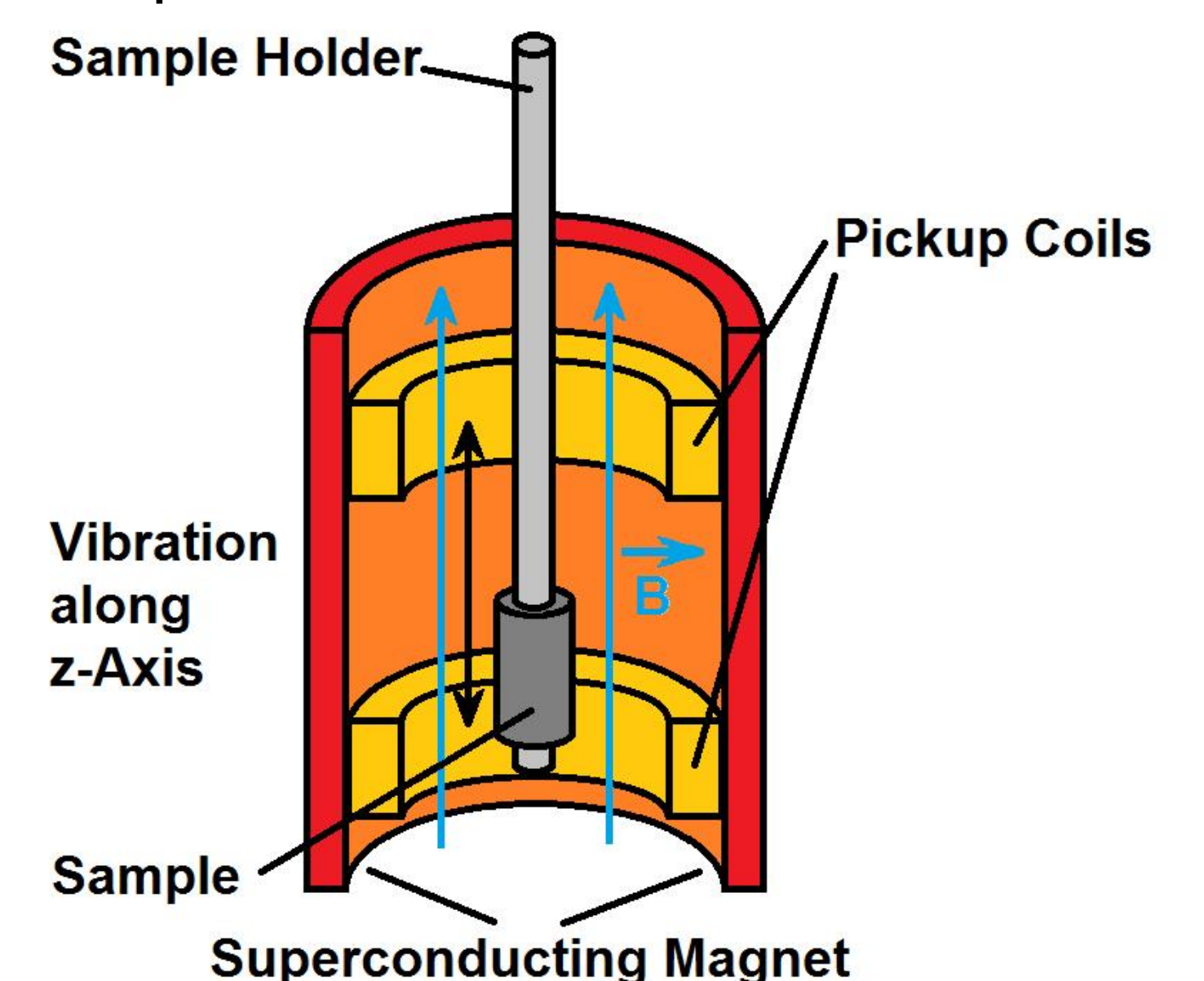
- o A cryostat incorporating a cryocooler, superconducting magnet and a variable temperature sample space.
- o Rack incorporating electronics for control and monitoring of the cryostat and any measurement options.
- o Measurement system software.
- o Sample probes.
- o Measurement options (VSM, Resistivity).



Vibrating Sample Magnetometer

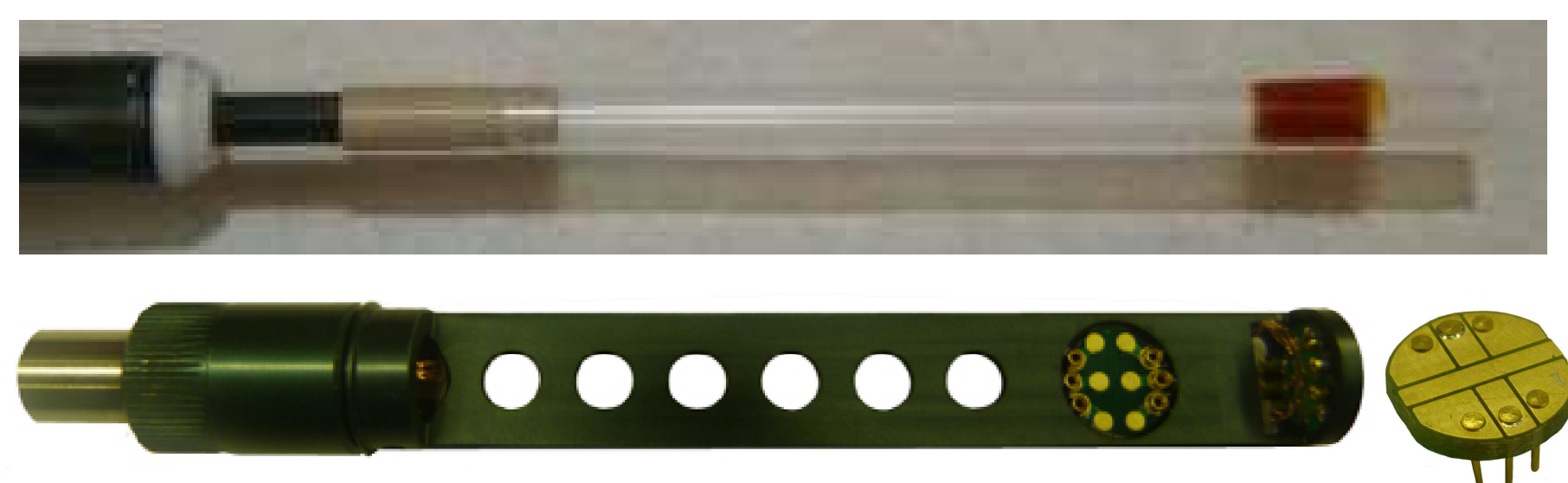
Vibrating Sample Magnetometer (VSM) is an instrument for measuring of magnetic properties of the material.

Principle: Small periodic movements (vibration) with magnetic sample in a uniform magnetic field through pickup coils induce alternating electrical field in coils. Detected voltage is proportional to the magnetic moment of the sample.

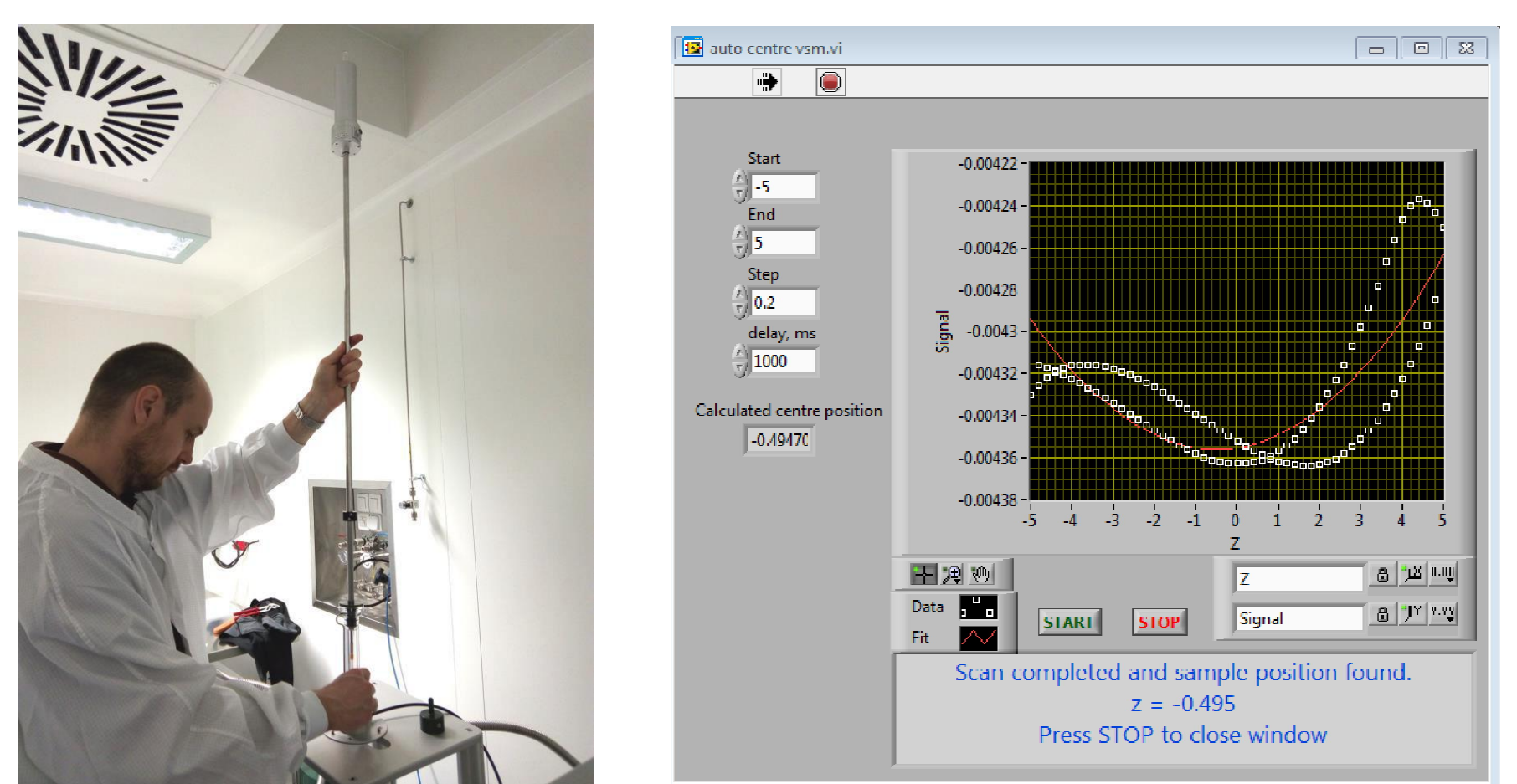


Mounting of the sample

Samples with maximum size of 10 mm are mounted on the special holders (VSM or Resistivity measurements).

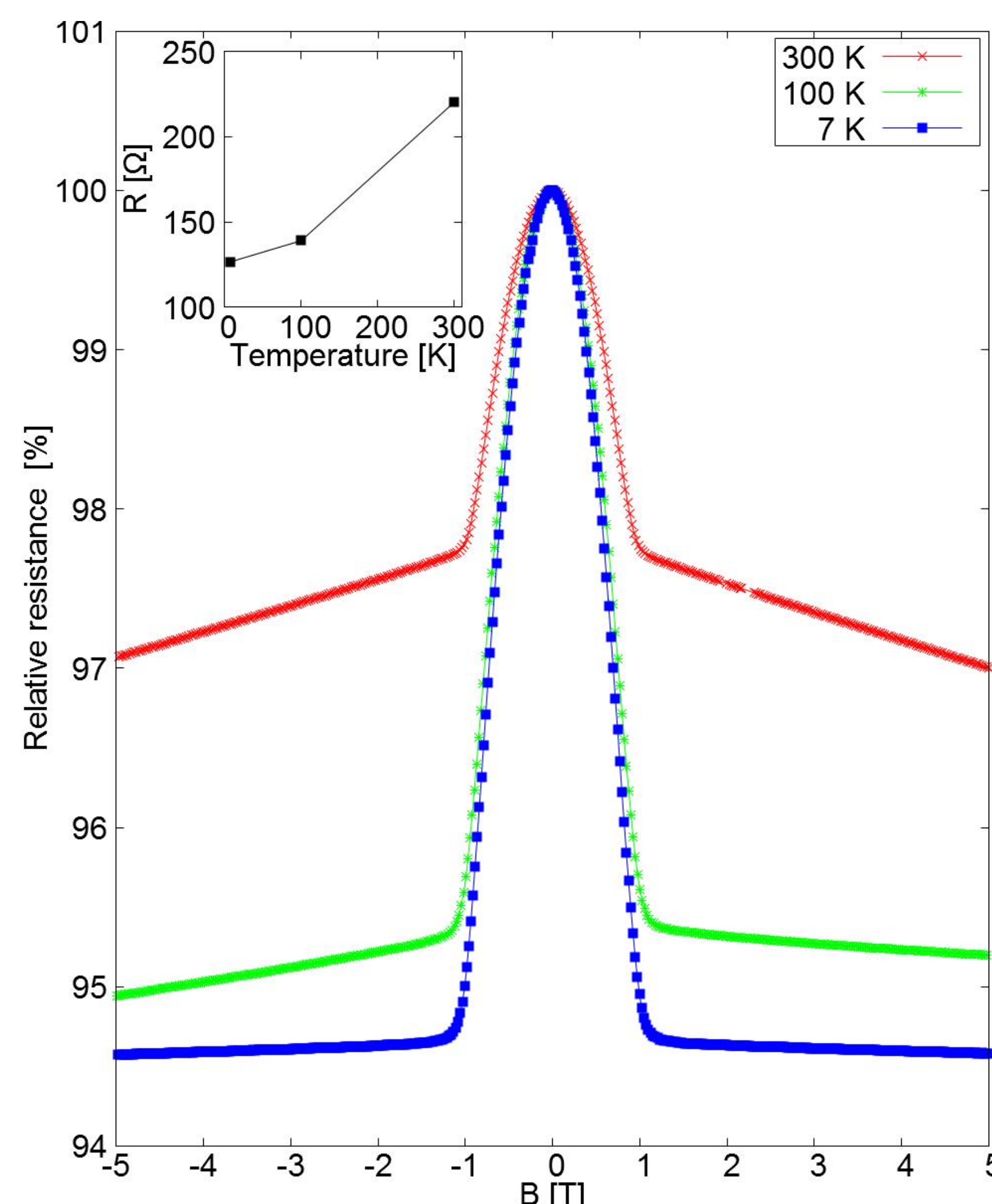


The holders are fitted to a probe rod which is inserted into the device. The correct position of the sample is found using autocentre utility.



Resistivity measurements

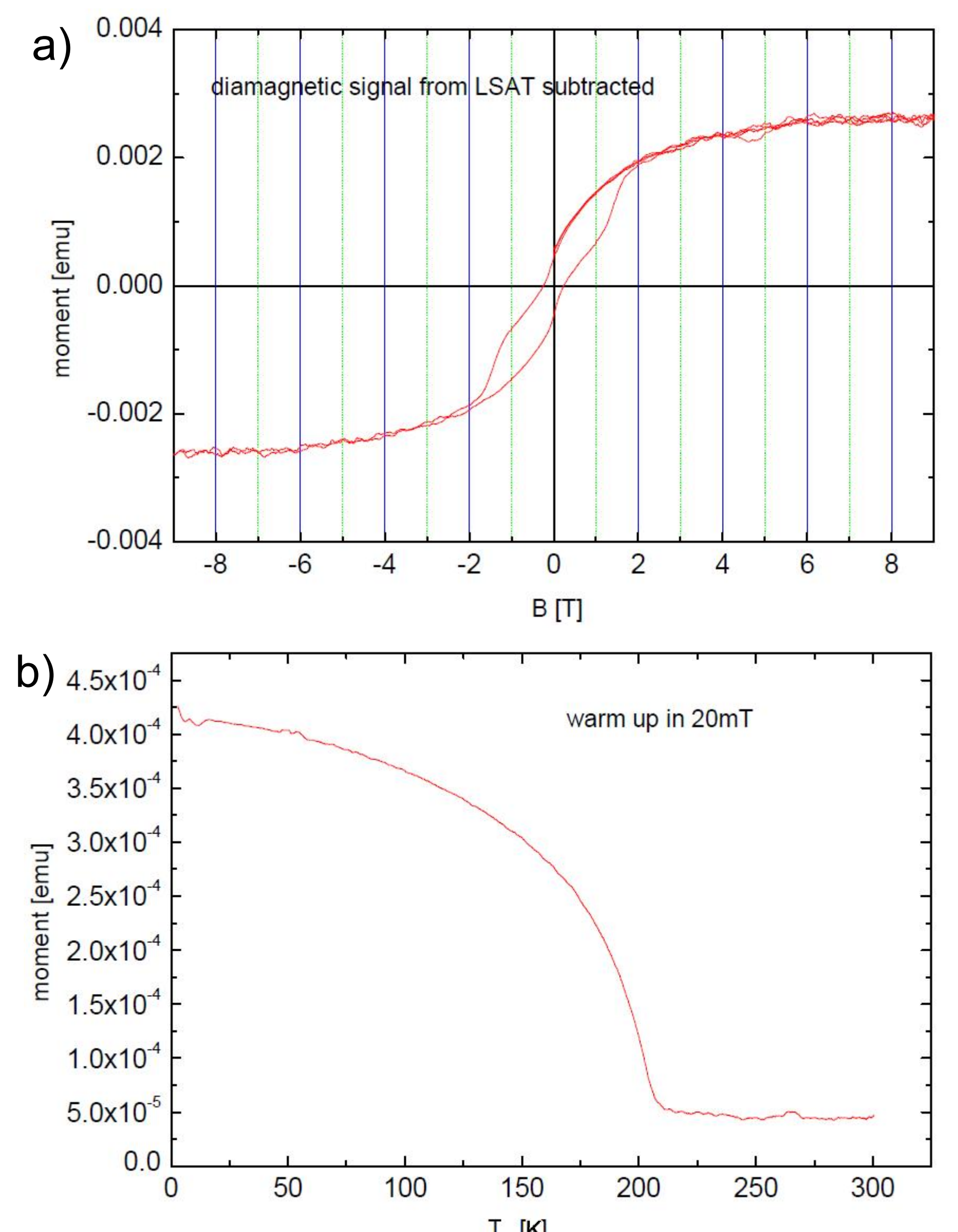
The Electrical Transport module provides the capability to perform DC resistance measurements and Hall voltage measurements in samples with resistance in the range from $1\ \mu\Omega$ to $1\text{ M}\Omega$ with variable temperature (from 1.6 K to 400 K) and magnetic field (from -9 T to 9 T).



Electrical transport measurements of NiFe wire with dimensions $1\ \mu\text{m} \times 100\ \text{nm} \times 100\ \mu\text{m}$ at three different temperatures.

VSM measurements

The Cryogenic VSM is designed to measure DC magnetic moment. It allows the measurements of magnetic hysteresis loops or temperature dependencies ($T = 1.6\text{ K} - 400\text{ K}$, $B = -9\text{ T} - 9\text{ T}$). Analysed samples can be in form of bulk, thin films, powders or liquids.



Hysteresis loop (a) and magnetization dependence on temperature (b) for 30 nm ferromagnetic layer $\text{La}_{0.7}\text{Sr}_{0.3}\text{CoO}_3$ on LSAT substrate.