μSR Results on $EtMe_3Sb[Pd(dmit)_2]_2$ and Developments of Gas-Pressurized High-Pressure SQUID and Transport Measurements Setups at the RIKEN-RAL Muon Facility

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We have been operating the RIKEN-RAL Muon Facility at the Rutherford-Appleton Laboratory in the UK for nearly 20 years. As a recent topic of μSR study, we report results on $EtMe_3Sb[Pd(dmit)_2]_2$ which is expected to have the spin-liquid state as its ground state. We found the root-H dependence of the dynamic muon-spin depolarization rate which shows the typical behavior of the dynamic diffusion of spin-excited states along the one dimensional direction. A possible ground state which is expected from the current result is discussed. In order to expand our research activities on the material science, we are developing the gas-pressurized high-pressure SQUID and transport measurements setups at the RIKEN-RAL. The current status and results of test measurements are reported.

≪μSR on $EtMe_3Sb[Pd(dmit)_2]_2$≫

In the last symposium, we have reported the observation of the non-magnetic ground state of $EtMe_3Sb[Pd(dmit)_2]_2$ in the zero-field condition down to about 25 mK. We have also reported the maintenance of the residual depolarization behavior even at the base temperature. In order to investigate the origin of this dynamic repolarization behavior, μSR measurements in longitudinal fields (LF-μSR) were carried out at the RIKEN-RAL down to 25 mK up to LF=4 kG. We have observed the LF dependence of the dynamic muon-spin depolarization rate is propotional to the root-LF at the base temperature. This field dependence is the typical behavior in the case that spin excited states diffuse along the one-dimensional direction. This root-LF behavior was observed till near 100 K at which the dynamic muon-spin depolarization rate starts to be smaller with increasing temperature. A possible origin of this root-LF behavior and also a possible model of the electronic state to explain our μSR results are discussed.

≪Gas-Pressurized High-Pressure SQUID System≫

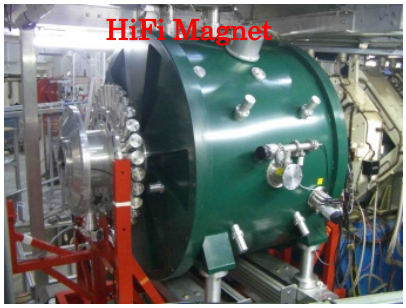
We have completed to install the system at the RIKEN-RAL. A commercially available SQUID magnetometer (Quantum Design Model-MPMS-1822) has been transported to the RIKEN-RAL and the high-pressure setup with the gas-pressurized

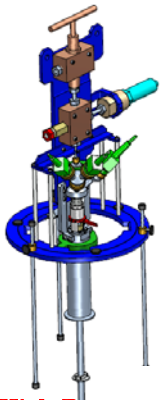
system has been connected. The pressure can be controlled from 0 to 5 kbar within the temperature range from 300 K down to 2 K. The external field can be applied up to 7 T. A test measurement has been done by using κ-(BEDT-TTF)$_2$Cu[N(CN)$_2$]Cl sample which has been installed in a pressure cell made by CuBe. It has been confirmed that the pressure can be controlled accurately at least 10 bar step. Results of the test measurement and the performance of the system are reported.

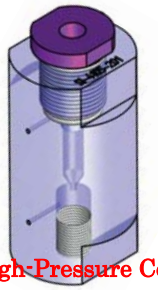

High-Pressure SQUID Setup

≪Gas-Pressurized Transport Measurements System with HiFi Magnet≫

The ISIS muon group has installed a superconducting magnet named HiFi (the right figure) for high-field μSR experiments. We have developed the gas-pressurized high-pressure transport measurement system which can be used with the HiFi magnet. By using both systems, extreme experimental conditions with the magnetic field up to 5 T, the temperature range from 300 K down to 2 K and the pressure range from 0 up to 7 kbar are available for measurements of transport properties. A special designed high-pressure center stick which can accommodate a high-pressure cell was assembled. This high-pressure center stick can be fitted to the existing cryostat for HiFi. The center stick has extra terminals in order to install additional wirings to measure the resistivity and the Hall coefficient under the pressure and strong fields. Pressurized tests at the maximum pressure at 2 K have been carried out and no leak of the pressure has been confirmed. We add a rotation gear to rotate the whole high-pressure center stick in the cryostat in order to measure the angular dependence of the transport properties against the external field. Results of the test measurements are reported.


HiFi Magnet


High-Pressure Center Stick


High-Pressure Cell

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