Activated tranport in the $\nu = 1$ bilayer quantum Hall states with small tunneling energy $\Delta_{\rm SAS} = 1$K

A. Fukuda[a], D. Terasawa[a], T. Morikawa[b], Y. D. Zheng[c], T. Arai[c], Z. F. Ezawa[d], and A. Sawada[c]

[a]Department of Physics, Hyogo College of Medicine, Nishinomiya, Japan
[b]Graduate School of Science, Department of Physics, Kyoto University, Kyoto, Japan
[c]Research Center for Low Temperature and Materials Sciences, Kyoto University, Kyoto, Japan
[d]Advanced Meson Science Laborary, Riken, Wako, Japan

The bilayer quantum Hall state (BQHS) has served as a good example of strongly correlated two-dimensional electron systems having the layer degree of freedom called pseudospin. These correlations manifest themselves in a variety of topological objects involving spins and/or pseudospins. In particular, the Landau level filling factor $\nu = 1$ BQHS can be interpreted as an ideal pseudospin XY-ferromagnet, where twin half-quantized vortices of pseudospins called "meron-pair" play an important role in the activated transport. A key feature of the XY-ferromagnet is to detect the Kosterlitz-Thouless (KT) phase transition. We carried out magnetotranport experiments in the $\nu = 1$ BQHS using a GaAs/AlAs double-quantum-well sample with tunneling energy as small as 1 K. We especially focus on activation energies and onset temperatures of the BQHS for a wide range of the total density and the layer density imbalance. We have found that the dependency of onset temperature on the total density is different from that of the activation energy. In this conference, we discuss possible phase transitions and topological excitations in the $\nu = 1$ BQHS from our experimental results.