Anisotropic nuclear spin relaxation and dynamic polarization rates in the $\nu = 2/3$ quantum Hall states

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The Landau level filling factor $\nu = 2/3$ quantum Hall states (QHSs) have been getting much attention to realize the spintronics or quantum computing device, owing to the controllability of their electron spin degeneracy. Furthermore, thanks to the weak hyperfine coupling between electron and nuclear spins, a long coherence time of nuclear spins, essential for such quantum devices, can be expected. However, detailed mechanism for the dynamic nuclear polarization (DNP) and spin relaxation, including the morphology of the domain structure consisting of the spin-polarized and spin-unpolarized states, has been unclear. We carried out magnetotransport experiments around the spin transition point in the $\nu = 2/3$ QHSs under the in-plane magnetic fields $B_{//}$, where magnetoresistance is believed to reflect the polarization of nuclear spins. We observed the highly anisotropic spin relaxation time and DNP rate for various source-drain currents I by mainly comparing with two different configurations: $I \perp B_{//}$ and $I \parallel B_{//}$. In the conference, we present the quantitative analysis of the rate of DNP and relaxation, and infer an anisotropic geometrical domain structure.