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Single-shot readout of electron high-spin states in a quantum dot coupled to quantum Hall edge states HARUKI KIYAMA, AKIRA OIWA, SEIGO TARUCHA, The University of Tokyo — The ability to prepare and probe an electron spin in a quantum dot (QD) is indispensable for spintronics and quantum information processing. Spin-resolved quantum Hall edge states (SRESs) are expected to be applied for such applications, since their spatial separation by two-dimensional electron gas (2DEG) edge potential provides spin-dependent tunnel coupling with QDs. However, the spin filtering efficiencies reported previously have not been high enough for spin injection and detection. In this work, we firstly enhanced the efficiency of the spin filtering by the electrical tuning of 2DEG potential landscape. Larger separation of SRESs are obtained by making the change of 2DEG potential near the tunnel barrier more gradual. Secondly, using the highly efficient spin filtering, we demonstrated single-shot readout of electron spins in a QD. The maximum visibility of two-electron spin readout reached to 94%. This is the highest value among reports in GaAs-based QDs. Subsequently we applied this scheme to measure the dynamics of the multi-electron high-spin states. We find that the spin relaxation rate of the S=3/2 or S=2 high-spin excited states to the S=1/2 or S=1 ground spin states are about 10 times faster than that of S=0 first excited state.

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