Spin polarization measurement of the $\nu = 5/2$ fractional quantum Hall state via NMR

LARS TIEMANN, NTT and ERATO-JST, GERARDO GAMEZ, NORIO KUMADA, NTT, KOJI MURAKI, NTT and ERATO-JST —

The $\nu = 5/2$ fractional quantum Hall state has attracted much interest due to its possible non-Abelian statistics, which are expected for the Pfaffian state. While the Pfaffian model assumes full spin polarization, recent optical experiments suggest a spin-unpolarized ground state at $\nu = 5/2$ instead [1, 2], and have thus posed a new challenge for understanding the true nature of the 5/2 state. Here, we report a spin polarization measurement of the $\nu = 5/2$ state using resistively-detected NMR and demonstrate its full polarization. The measurements were performed at $T = 10$ mK on a gated 30-nm quantum well at 4.4 T. For the resistive read-out of the nuclear resonance frequencies, we used the $\nu = 2/3$ spin transition by comparing its $R_{xx}$ prior to and after the application of an rf pulse at $\nu = 5/2$. The NMR spectrum at $\nu = 5/2$ is shifted to lower frequencies from the one at $\nu = 2$, where the system is unpolarized, indicating a nonzero polarization at $\nu = 5/2$. Our analysis, which considers the changes of the sub-band wave function under a gate bias, indicates that the polarization at $\nu = 5/2$ is very close to its maximal value. This, in turn, gives support for the Pfaffian state.