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Observation of a Well-Developed $\nu = 5/2$ Fractional Quantum Hall State in Low-Mobility Electron Systems GERARDO GAMEZ, KOJI MURAKI, NTT Basic Research Labs — The fractional quantum Hall (FQH) state at filling factor 5/2 is currently one of the hottest issues in FQH physics. This is mainly due to the predicted non-Abelian statistics of its quasiparticles and their possible implementation in quantum computation. However, experimental efforts to explore the 5/2 FQH state are severely hampered by the extremely high sample quality required for its emergence. Indeed, well-developed 5/2 FQH states have been reported only in samples with an ultra high mobility in excess of 1x10^7 cm^2/Vs. Here, we report the observation of a fully developed 5/2 FQH state in a GaAs/$Al_xGa_{1-x}As$ quantum well with a mobility of 4.8x10^6 cm^2/Vs, which was established after illumination at low temperatures by a red LED. To clarify the mechanism underlying the emergence of the 5/2 state, we carried out a systematic study on a series of samples with different parameters. Our study unveils that the screening of the remote impurity (RI) potential by the nearby neutral donors in the modulation doping layer plays the essential role. We also find that while the emergence of the 5/2 state is governed by the RI potential, once this state has emerged, the energy gap at 5/2 is still limited by the background impurity potential. Based on the analysis of the transport and quantum lifetimes, the relation between the 5/2 gap and these parameters will be discussed.

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