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Achievement of a new higher electron mobility plateau for GaAs quantum wells

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Two-dimensional electrons confined to GaAs quantum wells are hallmark platforms for probing electron-electron interaction. Many key observations were made in these systems as sample quality improved over the years. However, progress in quality has been stagnant for over a decade. We present a major breakthrough via source-material purification and innovation in GaAs molecular beam epitaxy vacuum chamber design. Our new samples have a world-record mobility of 44 _106 cm2/Vs at an electron density of 2:0 _1011 /cm2; this is the highest mobility observed in any material. These results imply only _1 residual impurity for every 1010 Ga/As atoms. The impact of such low impurity concentration is extraordinary; several new fractional quantum Hall states emerge, and exotic phases such as the 5=2 state, which is widely believed to be non-Abelian and of potential use for topological quantum computing, and stripe/bubble phases are unprecedentedly robust.