The spin polarization of the $\nu = 5/2$ fractional quantum Hall state

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In two-dimensional electron systems (2DES) under perpendicular magnetic fields, correlation effects are believed to create a non-Abelian state of matter [1], whose excitations could be exploited for topologically protected quantum operations. This non-Abelian state at a ratio of electrons to magnetic flux quanta of (filling factor ν) 5/2 [2] is currently the subject of intensive experimental and theoretical studies which try to identify its key properties. Among the various theories which have been proposed, the *Pfaffian* ground state [3] has arisen as the most desirable candidate. Recent experiments [4] were able to substantiate a quasiparticle charge of $e/4$, in agreement with the Pfaffian model. However, in order to rule out other less favorable Abelian states, the knowledge of the quasiparticle charge alone is not sufficient. In this presentation, we will report an experimental study of the electron spin polarization at filling factor $\nu = 5/2$, which is another important key property. The electron spin polarization is extracted from nuclear resonance spectra and their respective (Knight) shift at different filling factors.

Our resistively-detected NMR measurements, performed at $T \approx 10$ mK on a gated 30 nm wide quantum well sample patterned into a Hall bar, reveal that the $\nu = 5/2$ resonance spectrum shows a finite Knight shift which is indicative of a non-zero spin polarization. More specifically, our careful analysis indicates that the spin polarization at filling factor 5/2 is very close to its maximal value over a wide range of electron densities. This, in turn, gives support for the *Pfaffian* wave function over other proposed wave functions.

[1] A. Stern, *Nature* **464**, 187 (2010)

[2] R. L. Willet, J. P. Eisenstein, H. L. Stormer, D. C. Tsui, A. C. Gossard, and J. H. English, *Phys. Rev. Lett.* **59**, 1779 (1987)

[3] G. Moore and N. Read, *Nucl. Phys. B* **360**, 362 (1991)

[4] R. L. Willett, L. N. Pfeiffer, and K. W. West, *Proc. Natl. Acad. Sci.* **106**, 8853 (2009); M. Dolev, M. Heiblum, V. Umansky, A. Stern, and D. Mahalu, *Nature* **452**, 892 (2008); I. P. Radu, J. B. Miller, C. M. Marcus, M. A. Kastner, L. N. Pfeiffer, and K. W. West, *Science* **320**, 899 (2008); V. Venkatachalam, A. Yacoby, L. Pfeiffer, and K. West, *Nature* **469**, 185 (2011)

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