Anomalous magnetic properties of strongly correlated electrons on a semiconductor surface: Experimental study

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The interplay between strong Coulomb interactions and randomness has been a long-standing problem in condensed matter physics. New evidence has emerged within the past decade indicating existence of a metallic phase (and, consequently, a metal-insulator quantum phase transition) in two-dimensional systems of *strongly interacting electrons* [1,2]. Recent observation of sharply increasing spin susceptibility in the immediate vicinity of the critical point suggests that the metal-insulator transition may be related to ferromagnetic instability [3].

I will report results of careful measurements of low-temperature spin and orbital thermodynamic magnetization in a strongly correlated two-dimensional electron system in ultra-high quality silicon metal-oxide-semiconductor field-effect transitions (MOSFETs). Our experimental data suggest, in particular, that the magnetic field, at which electrons become fully spin-polarized, tends to vanish at a finite electron density, suggesting that spontaneous spin polarization may occur at this density. These results are consistent with those obtained by measurements of the chemical potential, analysis of the low-field Shubnikov-de Haas oscillations, and measurements of the magnetoresistance in a parallel magnetic field. Furthermore, the data obtained by several methods show that the effective mass dramatically increases when the metal-insulator transition is approached, while the *g*-factor remains close to its value in bulk silicon (see figure 1). All these results demonstrate that two-dimensional system of strongly correlated behaves well beyond a weakly interacting Fermi liquid.

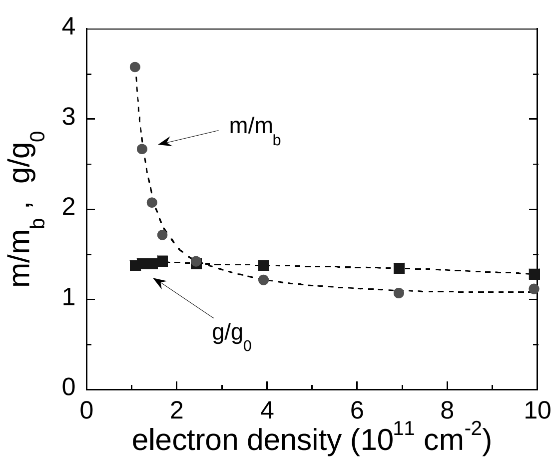

Fig.1 The effective mass (circles) and *g*-factor (squares) versus electron density.

References:
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[3] A. A. Shashkin, S. V. Kravchenko, V. T. Dolgopolov, and T. M. Klapwijk, *Phys. Rev. Lett.* **87**, 086801 (2001).