POSSIBLE EXCITONIC BCS-LIKE STATE IN GRAPHITE AT HIGH MAGNETIC FIELDS.

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Graphite is an elemental semimetal having small carrier densities of ~ 3 x 10^{18} cm^{-3} for both electrons and holes. Consequently, the quasi-quantum limit state, where only the lowest electron-like (Landau index $n = 0$, spin ↑ and ↓) and hole-like ($n = -1$, ↑ and ↓) subbands are populated, is realized in a moderate magnetic field of 7.4 T applied along the *c*-axis. Further increase in magnetic field causes successive transitions at fields of ~ 30 T, 53 T and 75 T, while its underlying physics remains unclear [1, 2].

To clarify the origin of these transitions, we performed measurements of magnetization, magnetoresistance, and Hall resistance on various kinds of single crystals and highly oriented pyrolytic graphite in pulsed high magnetic fields up to 75 T [3]. In the differential magnetization curves, we observed a significant anomaly at ~ 53 T, which is comparable to those in dHvA oscillations at the low field region. The measured Hall resistance approaches zero above this field. In addition, comparison of the results for various graphite samples in this study and the neutron irradiate ones reported earlier [4] suggests that this transition field decreases with doping holes to graphite. All these results are reasonably explained if two of the four Landau subbands are depopulated, namely quantum limit state is realized, at ~ 53 T.

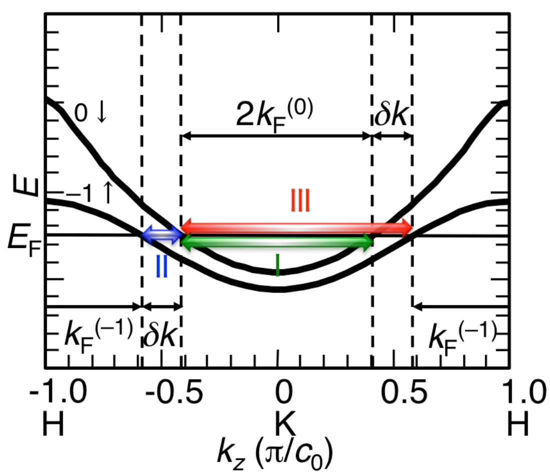

Figure 1. Schematic image of the proposed structure of Landau subbands and possible nesting vectors above 53 T.

Recent experiment revealed the emergence of an insulating state above 53 T [2], implying a nesting between the residual Fermi points in this quasi-one dimensional system at the high field limit. In the expected dispersion relation shown in Fig. 1, the nesting vector I corresponds to the CDW state, whereas the vectors II and III have been regarded as the excitonic phase [5]. We will discuss the possible excitonic BCS-like state in this field region [3].

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