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スピン回転干渉計の動作検証

A spin-rotation interferometer

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The electron interference effect in spatial kinetic freedom space has been exhaustively studied, and in spintronics the interference in spinor space shoulc also be taken into account[1]. A simlest device, maybe, is a two-path interferometer with paths, through which the spin rotation can be tuned with *e.g.*, gate voltages[2]. Here we confirm that such a two path interferometer can work as an interferometer in the spinor space and the gate voltage can rotate the electron spin.

Figure 1(a) shows the gate configuration (white regions) on $In_{0.1}Ga_{0.9}As$ quantum well. The Two paths are indicated by yellow broken lines. At low temperatures (~120mK), clear oscillation in the conductance against the gate voltage of one of the paths appears as shown in the middle panel of Fig.1(a). There is, also Aharonov-Bohm (AB) oscillation against the magnetic field, hence in two-dimensional Fourier transformation (2DFT) peaks appear at finite coordinates. Interestingly the number of peaks is four as in the bottom panel in Fig.1(a) indicating that the interference “lines” are crossing as shown in Fig.1(b). This means that the oscillation against the voltage is not due to the space interference but due to the spin interference. The inference can also be confirmed by applying strong magnetic field (1T) to fix the spin direction and kill the spin intereference oscillation. As shown in Fig.1(c) the four peak points in 2DFT collapse into two with applying 1T, confirming the above inference.

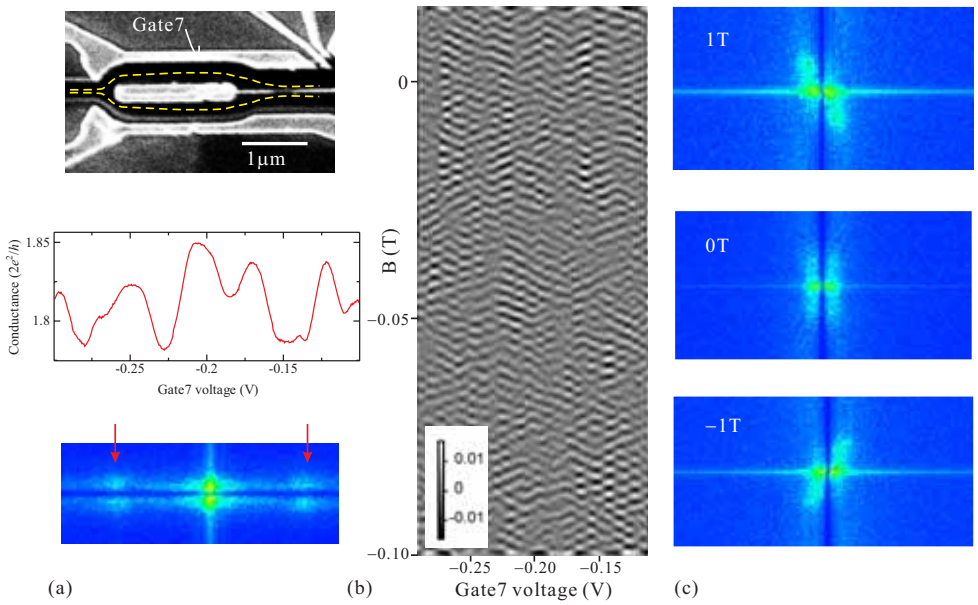

Fig.1 (a) Top: gate configuration. Middle: conductance oscillation against gate-7 voltage. Bottom: 2DFT of the oscillation in voltage-magnetic field plane. (b) Inverse 2DFT. (c) 2DFT for 0T and ±1T.

References

[1] J. Nitta, F. E. Meijer, H. Takayanagi, Appl. Phys. Lett. **75**, 695 (1999).

[2] M. Yamamoto, *et al.*, Nature Nanotech. **7**, 247 (2012).