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Monitoring electron spin decoherence in a quantum dot by weak measurement[1] SHU HONG FUNG, RENBAO LIU, The Chinese University of Hong Kong — Based on the fluctuation-dissipation theorem, information about the dynamics of a system could be derived by noise spectra with passive probe, in lieu of active pump-control-probe procedures. For a quantum system, the passive probe still needs to be weak lest the system is disturbed by state collapse. We consider the weak measurement by Faraday rotation (FR) of a single spin in a quantum dot under an external magnetic field in the Voigt configuration. The quantum dot is repeatedly probed by linearly polarized laser pulses. The FR caused by a single spin is extremely small (about a few millionth rad), so the photon states with different rotation angles, and hence the electrons spin states, are only weakly distinguished. The polarized light beam is filtered by a polarized beam splitter and the reflected photons are counted. The second order correlation of the photon count shot noise oscillates with a rapid damping caused by the inhomogeneous broadening (which exists even for a single spin under repeated measurements). In the third order correlation, the single spin decoherence is singled out from the rapid inhomogeneous dephasing, which would otherwise require spin echo.

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Shu Hong Fung
The Chinese University of Hong Kong

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