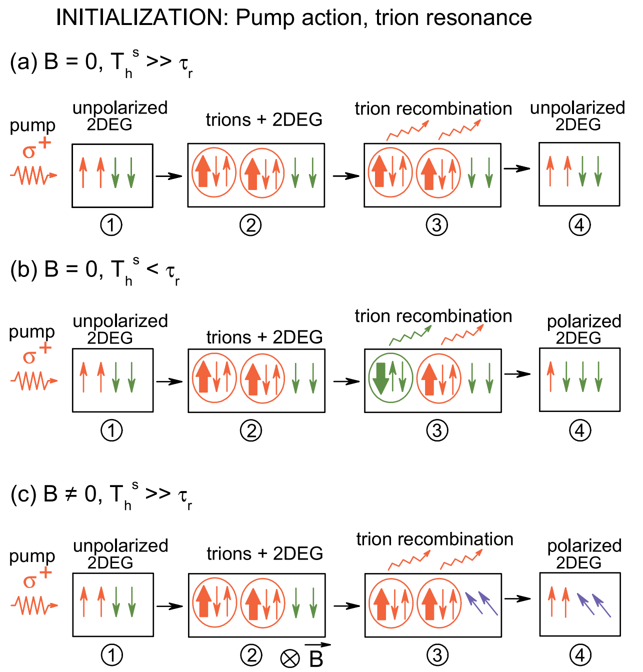

FIG. 5: (Color online) Spin orientation of resident electrons denoted as 2DEG (two-dimensional electron gas) for trion resonant excitation. The following four stages are shown: (1) unpolarized 2DEG before excitation; (2) result of action of a σ^+-polarized pump pulse, part of the resident electrons are bound to trions; (3) trions and resident electrons shortly before trion recombination; (4) 2DEG after trion recombination. Panels (a) and (b) show the situation for zero external magnetic field. (a) $T_s^h \gg \tau_r$, hole spin flip is absent and resident electrons stay unpolarized after trion recombination. (b) $T_s^h < \tau_r$, hole spin relaxes before trion decay and resident electrons become spin polarized. (c) Non-zero external magnetic field. Even in the absence of hole spin relaxation the resident electrons become polarized due to electron spin precession about magnetic field during trion lifetime.

usual shape [Fig. 4(d)] has maximum at exciton pumping and (ii) this amplitude increases with increasing of pump power and disappears with decrease of pump power. It allows us to conclude that the main contribution to the RSA signal with shape shown in Fig. 4(d) is due to electron spins polarized by electron-exciton scattering or due to fast spin relaxation of hole in the resonantly excited exciton.

V. LOW TEMPERATURE SPIN DYNAMICS

We turn now to the evolution of the spin dynamics of electrons and holes and in particular to the mechanisms providing carrier spin relaxation at extremely low temperatures down to 430 mK. We focus on the Faraday rotation RSA signals measured at the trion resonance, where the hole spin dynamics is most pronounced. Figure 7 shows RSA signals measured at the trion resonance

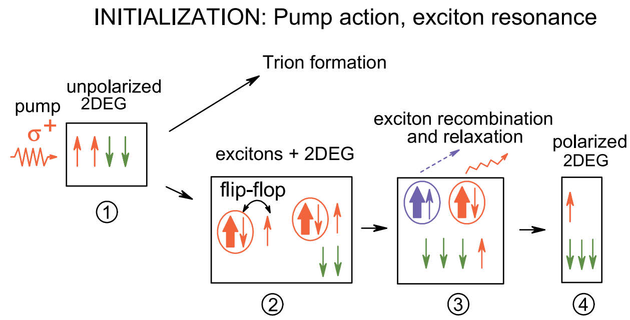

FIG. 6: (Color online) Spin orientation of resident electrons at exciton resonant excitation. Two possible scenarios are depicted: trion formation from the photocreated exciton and flip-flop scattering of an exciton with a resident electron. In this case the exciton is transformed into ta dark state and the resident electrons become polarized after the dark state has decayed (shown by blue dashed arrow).

energy for various temperatures. We fit the experimental RSA spectra from Fig. 7 by Eq. (5) and get very good agreement in all cases. The g-factors and spin relaxation times determined in that way are given in the figure caption.

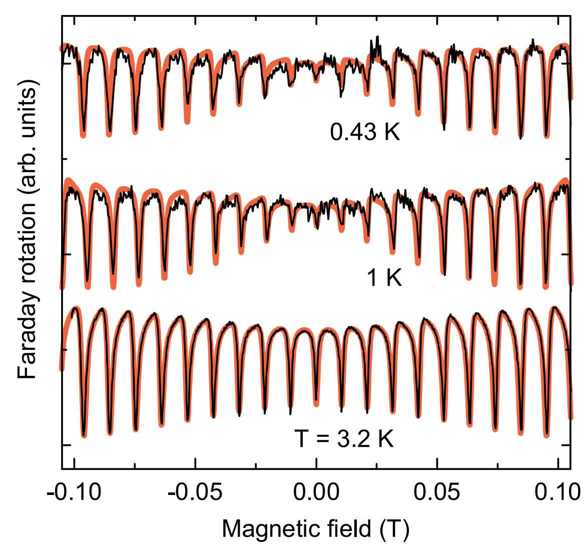

FIG. 7: (Color online) RSA signals measured by degenerate pump-probe Faraday rotation at the trion resonance for various temperatures. Black curves are experimental data and thick red (grey) curves are fits by Eq. (5). Calculation parameters are: $|g_e| = 0.555$, $T_s^e = 45$ ns, for $T = 0.43$ K: $T_s^h = 2$ ns, $\tau_r = 200$ ps; for $T = 1$ K: $T_s^h = 2$ ns, $\tau_r = 200$ ps; for $T = 3.2$ K: $T_s^h = 0.6$ ns, $\tau_r = 120$ ps.

The electron and hole spin relaxation times measured at different temperatures are collected in Fig. 8. The data for temperatures below 15 K were determined from RSA spectra and for higher temperatures, at which the RSA signals vanish, we fit the decay of the FR signals at positive delays. The data in the temperature range