Appendix D

Chapter 5

D-I Occupation probabilities

To demonstrate the absence of the irreversible work and adiabaticity of the cycle we have plotted the level populations for the relatively high populated energy levels. For the stroke **ii** occupation probabilities $P_n(D, T_H)$ for the first few low-lying states $|n\rangle$ are calculated. The system was initiated at the equilibrium Gibbs thermal state $\rho(D_0, T_H)$ (the system at temperature $T_H = 0.5$ was initiated with DMI parameter value $D = D_0 = 0$), and DMI parameter is steered to $D = D_1 = 1.0J$. The diagonal elements ρ_{tnn} of the propagated state $\rho_t(D, T_H)$ are the occupation probability for respective eigenstates. The results are shown in Fig. D.1. As we see all level populations stay constant during the whole stroke. Similar results are obtained for temperature T_L (stroke **iv**) as well. We have also shown the dependence of energy levels on the DMI constant $E_n(D)$ (i.e., the driving parameter of the working strokes). While level populations are constant, the energy spectrum has a complex character (Fig. D.2).

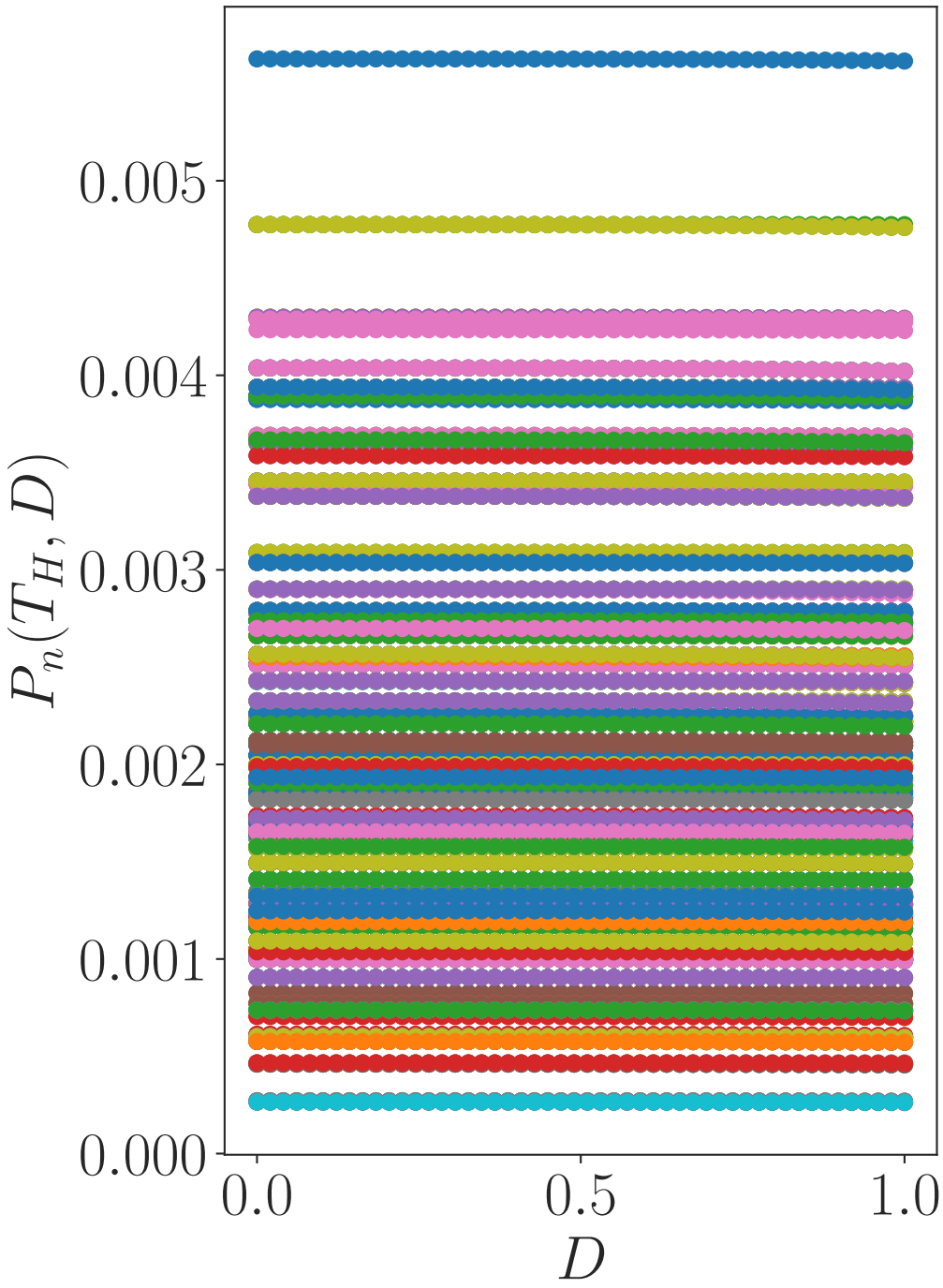

Fig. D.1 Occupation probabilities $P_n(D, T_H)$ for the first few low-lying states $|n\rangle$. System initiated at the equilibrium Gibbs thermal state $\rho(D_0, T_H)$ (system at temperature $T_H = 0.5$ initiated with DMI parameter value $D = D_0 = 0$.)

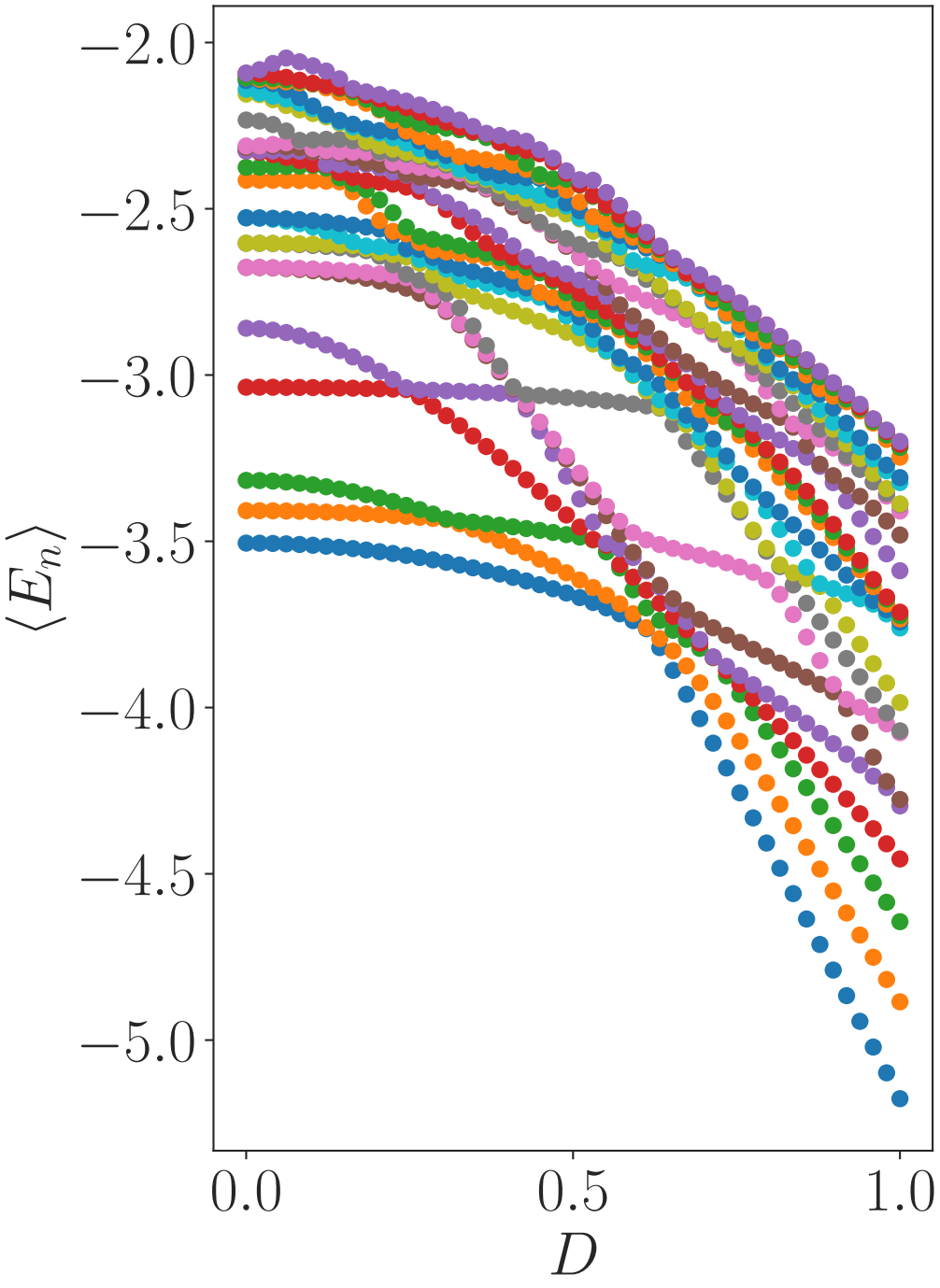

Fig. D.2 Dependence of energy levels on the DMI constant $E_n(D)$ (system at temperature $T_H = 0.5$ initiated with DMI parameter value $D = D_0 = 0$).