The high-frequency asymptotes of the spin correlation function for a dilute Heisenberg paramagnet

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The line shape of correlation function can yield information about, for example, rate of equilibration in heterogeneous spin systems that is relevant to the problems of ergodicity, thermalization, spin transport, and many-body localization.[1] Its wings decrease exponentially with frequency when the spin autocorrelation function (ACF) has singular points on the imaginary time axis. The coordinates of the singular points that determine exponential decay were calculated for regular spin lattices.[2] The dependence of coordinate on the magnetic concentration does not seem to have been considered. It should be noted that the disordered system can be replaced by the regular lattice of spins at average distance to obtain the coordinate of singular point.[3] However, the legitimacy of such a substitution is questionable, since the calculations of the central part of the ACF line shape indicate the importance of taking into account a non-uniformity in spatial distribution of spins.[4] We have investigated the singular points on the imaginary time axis of the ACF, averaged over the distribution of the spins in the magnetically dilute lattice with isotropic spin-spin interaction at infinite temperature. For the ACF in the approximation of a self-consistent fluctuating local field we propose the system of nonlinear integral equations considering irregular locations of spins. The coordinate of the nearest singular point is defined by the radius of convergence of time series where the coefficients of expansion are calculated by recurrent equations. It is shown that in the limit of extreme dilution this coordinate and, consequently, the shape of the ACF has logarithmic asymptotes (*Fig. 1*).[5] Our analysis leads to conclusion that the spins of magnetically dilute system that play an important role in establishing equilibrium between different parts of system and shape the center of the ACF spectrum are located at average distance. However, the wings are determined by clusters which have small probabilities and give large contribution to the modulation frequency.

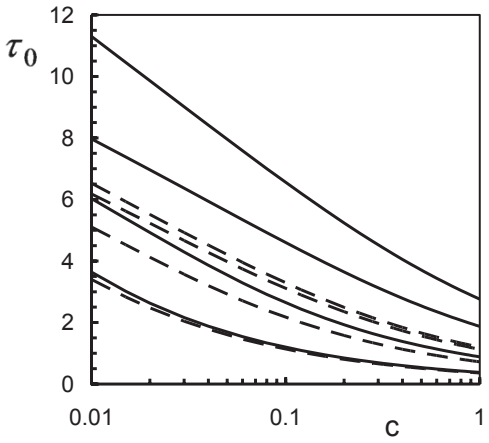

Figure 1. *Coordinate of the nearest singular point as a function of the magnetic concentration for contributions from close (Z=3-solid; Z=5-dash) and residual spins* δ^2/b^2 *(from top to bottom): 0; 0.03; 3; 30, where* $c\delta^2 = M_2 - cZb^2$, M_2*–second moment,* b*– coupling constant between close spins.*

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