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Origin of magnetic anomalies and relaxation mechanisms in ferrofluids M. B. MORALES, M. H. PHAN, N. A. FREY, S. PAL, H. SRIKANTH, Dept. of Physics, University of South Florida — From a fundamental physics perspective, it is proposed that blocking of magnetic nanoparticles and freezing of a carrier fluid would affect the magnetization and relaxation processes in ferrofluids. To verify this hypothesis, we have conducted systematic DC magnetization and AC susceptibility studies in different ferrofluids composed of Fe_3O_4 and $CoFe_2O_4$ nanoparticles suspended in hexane and dodecane, which respectively have freezing temperatures below (178K) and above (264K) the blocking temperature of magnetic nanoparticles (∼200K). Experimental results reveal that the particle blocking and carrier fluid freezing effects play key roles in the formation of glass-like relaxation peaks in ferrofluids, which remained largely unexplained in previous studies. It is also shown that the nature of these peaks is strongly affected by varying particle size and carrier fluid medium. Quantitative fits of the frequency dependent AC susceptibility to the Vogel-Fulcher model, $\tau = \tau_o \exp[E_a/k(T\text{-}T_o)]$, clearly indicate that the blocking of magnetic nanoparticles in the frozen state significantly affects the interparticle dipole-dipole interaction, causing characteristic spin-glass-like dynamics. A clear correlation between the blocking and freezing temperatures emerges from our studies for the first time.

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