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Spin glass state structure theory and its application to explain experiments

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The authors have found the general description of all the eight fundamental magnetic structures and their symmetry groups (including spin glass state - sgs) with the use of the fibre bundle approach [1]. The structure of sgs turns out to consist in the Gaussian-like randomness of the orientations of all the separate atomic magnetic moments in the sample. It means that the magnetization vector M is also subject to Gaussian distribution. Thus the structure of the sgs is represented by the magnetization vector situated along the generatrix of a certain cone whose axis coincides with the direction of an internal spontaneous magnetic field indispensable for stability of the sgs in a sample [2]. The axis of the 3-dimensional Gaussian distribution mentioned above coincides also with the same direction. Every precession angle of M around this field makes the symmetry operation of sgs once the angle between M and this field remains constant. Thus the symmetry group of sgs turns out to be SO(2). The temperature dependence of magnetic susceptibility of sgs in the alloys CuMn [3] corresponds when heating to the gradual degeneration of the Gaussian distribution of the magnetization vector, and when cooling to its gradual recovery with no hysteresis. In both cases an internal spontaneous magnetic field mentioned above plays an essential role. The interrelation of this field, of the Gaussian distribution mentioned above, of the average kinetic energy of magnetic atoms and of the frustration of orientations of the magnetic moments placed on these atoms will be discussed.

[1] *J. Warczewski, P. Gusin, D. Wojcieszyk: Mol. Cryst. Liq. Cryst. 554 (2012), 209-220,* ***[2]*** *J. Warczewski, P. Gusin, et al., J. Phys.: Condens. Matter, 21 (2009), 035402-035406,* ***[3]*** *S. Nagata, P.H. Keesom, H.R. Harrison, Phys. Rev. B 19, 1633 (1979)*

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