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$Tb_2Mo_2O_7$: Spin glass, spin ice and possible candidate for magnetic monopoles exploration

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The frustrated pyrochlore compound $Tb_2Mo_2O_7$ stands at an interesting crossroads, being a representative of both the Mo-based family $R_2Mo_2O_7$ (R = rare earth) and other Tb-based compounds $Tb_2X_2O_7$ (X = metal). As a function of the R-site radius, $R_2Mo_2O_7$ compounds exhibit a metal-insulator transition between the ferromagnetic metal states and the spin glass insulators. $Tb_2Mo_2O_7$ exhibits the spin-glass behavior, $T_G \sim 24$ K, despite the apparent lack of chemical disorder. This compound crystallizes in a cubic space group in which both the Tb and Mo atoms form three-dimensional networks of corner-sharing tetrahedra. Thus, each magnetic ion resides on a highly frustrated pyrochlore lattice. Neutron scattering measurements on single crystal specimens of $Tb_2Mo_2O_7$ revealed the short-ranged spin arrangements resembling the "spin ice" structure with Tb moments slightly tilted off the local <111> -direction. Detailed analysis of a.c. and nonlinear susceptibilities suggest that $Tb_2Mo_2O_7$ is not sufficiently frozen below glass transition, rather finite spin dynamics persists to the lowest measurement temperature. Such nonconventional glassy behavior is also reflected in thermodynamic scaling of the nonlinear susceptibilities. In addition to the spin ice configuration and a nonconventional spin glass transition, $Tb_2Mo_2O_7$ also exhibits **Q**-independent temperature dependent background. Similar experimental observations in an isostructural pyrochlore, $Ho_2Ti_2O_7$, were identified as distinct signatures of Dirac's effective magnetic monopoles. Thus $Tb_2Mo_2O_7$ provides a new frontier to extend this noble quest.