KAZAN FEDERAL UNIVERSITY
ZAVOISKY PHYSICAL-TECHNICAL INSTITUTE
TATARSTAN ACADEMY OF SCIENCES

# ACTUAL PROBLEMS OF MAGNETIC RESONANCE AND ITS APPLICATION

## XXII International Youth Scientific School

# Program and Proceedings

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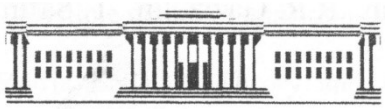

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## Van Vleck paramagnets – new features in comparison of $LiTmF_4$ and $Li(Tm_{0.02}Y_{0.98})F_4$: NMR study

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Both of the $Li(Tm_{0.02}Y_{0.98})F_4$ and $LiTmF_4$ are Van Vleck paramagnets (VVP). They have a singlet ground state and the nearest excited doublet state of the ground multiplet in a paramagnetic rare-earth ion [1]. Van Vleck paramagnets could be researched by NMR method due to a gigantic induced magnetic field at the rare-earth nucleus as a consequence of strong hyperfine interaction. We reported the study of $^{169}Tm$ nucleus in diluted single crystal VVP $Li(Tm_{0.02}Y_{0.98})F_4$ in comparison with our the newest obtained data of $LiTmF_4$.

Van Vleck paramagnets $LiTm_{0.02}Y_{0.98}F_4$ and $LiTmF_4$ both have a tetragonal structure of scheelite ($CaWO_4$) with a space group $C_{4h}^6$ [2]. NMR studying of VVP single crystals were carried out by pulse home-built spectrometer. Magnetic field range was 0–0.8 T, working frequencies were 14.15 MHz, 8.43 MHz and 8.16 MHz, temperature range was 2–4.2 K.

As a result of a series of experiments, an anisotropy of the spin-spin relaxation rate ($T_2^{-1}$) close to the direction [001] were measured and calculated for both VVP single crystals $Li(Tm_{0.02}Y_{0.98}F_4)$ and $LiTmF_4$. Angular dependence of a spin-lattice relaxation rate ($T_1^{-1}$) were measured for a diluted VVP $Li(Tm_{0.02}Y_{0.98}F_4)$. The inhomogeneous linewidth was obtained for the $Li(Tm_{0.02}Y_{0.98}F_4)$ and compared with a results for concentrated VVP $LiTmF_4$.

Temperature dependencies of $T_1^{-1}$ and $T_2^{-1}$ were measured for the $Li(Tm_{0.02}Y_{0.98}F_4)$. Energy interval between the singlet ground state and first excited doublet state was obtained from approximation of experimental results and reached 25.9±0.2 $cm^{-1}$ in approach of two-phonon Aminov-Orbach relaxation process. It is markedly different from previously known value for the concentrated $LiTmF_4$ which was 31 $cm^{-1}$ [3]. According to this result, we assumed different roots of correlation time in cases of diluted $Li(Tm_{0.02}Y_{0.98}F_4)$ and concentrated Van Vleck paramagnets $LiTmF_4$.

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