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The mechanism of superconductivity in the controversial spinel oxide $LiTi_2O_4$ clarified with LEμ^+SR

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The very first low-energy muon spin rotation (LE-μ^+SR) study performed on $LiTi_2O_4$ films in the Meissner state is presented. $LiTi_2O_4$ is a unique spinel type superconductor in which the mechanism underlying superconductivity is highly debated **[1]**. LE-μ^+SR is a direct probe for the characterization of depth dependent properties in thin films, which allowed us to extract the London penetration depth ($\lambda_L = 241 \pm 15$~nm) and the temperature dependence of the superconducting order parameter for $LiTi_2O_4$, among other relevant quantities. The order parameter was found to not follow any of the standard models within the realm of the mean field theory. In particular, the value of the critical exponent, close to 1, suggests that the superconductivity in $LiTi_2O_4$ is of unconventional nature. Indeed, by plotting the correlation between the critical temperature Tc and the London penetration depth for $LiTi_2O_4$ in Uemura's scaling relation for doped cuprates, we see that its behavior is close to the one of electron doped cuprates. We concluded that the observed behavior is compatible with a superconductivity of BCS type, with disturbance by Ti3+ spin fluctuations, which introduce a time reversal symmetry breaking perturbation in the system. This measurement gives a robust indication that LTO is a nonconventional SC and sets an important step forward in understanding the controversial nature of superconductivity in this material.

[1] E. G. Moshopoulou, J. Am. Ceram. Soc., 82 [12] 3317–20 (1999)

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