Muon Spin Relaxation (μSR) Study on the Parent Material $RNiO_2$ (R = La, Nd) of the New Nickelate Superconductors

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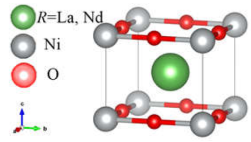
Motivations

A study of the parent material $RNiO_2$ (R = La, Nd) of the new nickelate superconductors to investigate;
(1) Zero field μSR to check long-range magnetic order or magnetic fluctuations;
(2) Longitudinal field μSR to study magnetism or spin dynamics under field evolution.



➢ Zero field μSR Time Spectra

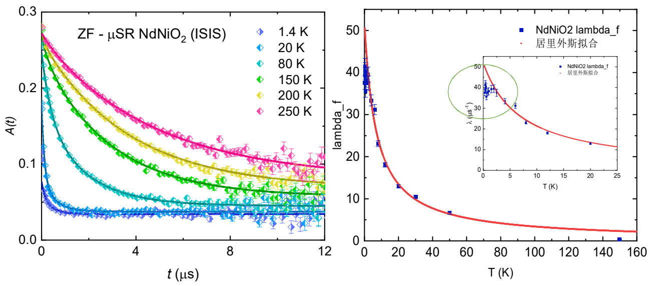


FIG. 1 (left) Zero field μSR time spectra of $NdNiO_2$. The corresponding solid lines are fit according to Eq. (1). (right) fast muon depolarization rate over temperature.

- ➢ **No long range magnetic order in $NdNiO_2$ down to 0.28 K.**
- ➢ **The magnetic fluctuations is very strong even up to 250 K.**
- ➢ **Low temperature magnetic fluctuation frequency is about 40 MHz.**
- ➢ **The platform appears in the low temperature section of the fast muon depolarization rate over temperature while the high temperature section can be fitted in Curie-Weiss law.**

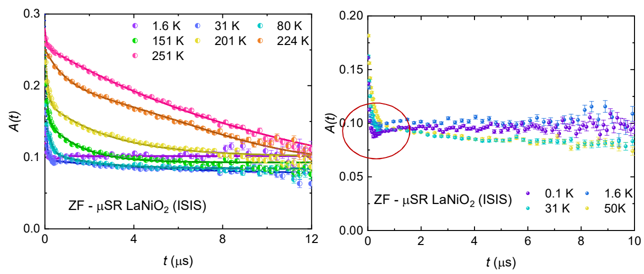


FIG. 2 Zero field μSR time spectra of $LaNiO_2$. The corresponding solid lines are fit according to Eq. (2). Left and right are spectra at high and low temperatures, respectively.

$$A(t) = A_0(1-f_{bg})(f_f e^{-\lambda_f t} + (1-f_f)G_{KT}(t)) + A_0 f_{bg} \quad (3)$$

$$G_{KT}(t) = \frac{1}{3} + \frac{2}{3}(1-\sigma^2 t^2)e^{-\frac{\sigma^2 t^2}{2}} \quad (4)$$

- ➢ **No long range magnetic order in $LaNiO_2$ down to 0.1 K.**
- ➢ **Quasi-static magnetic order emerges near 50 K ?**

➢ Longitudinal field μSR Time Spectra

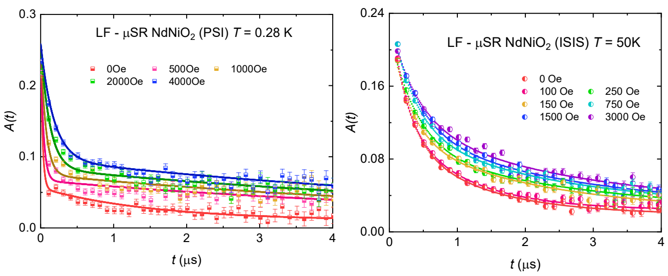


FIG. 3 Longitudinal field μSR Time Spectra of $NdNiO_2$. (a) T = 0.28 K (left). (b) T = 50 K (right). The corresponding solid lines are fit according to Eq. (1).

$$A(t) = A_0(1-f_{bg})(f_f e^{-\lambda_f t} + (1-f_f)e^{-\lambda_s t}) + A_0 f_{bg} \quad (1)$$

$$\lambda_f = \frac{C}{T-T_C} \quad (2)$$

- ➢ **The magnetic fluctuations is very strong even up to 0.4 T.**

➢ Longitudinal field μSR Data Analysis

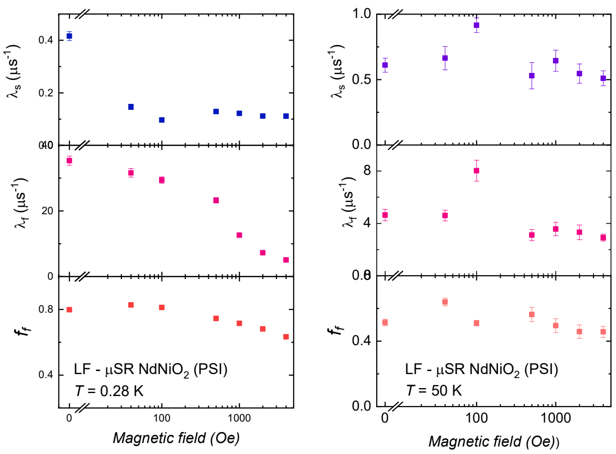


FIG. 3 Longitudinal field μSR data analysis of $NdNiO_2$. (a) 0.28 K (left). (b) 50 K (right)

- ➢ **Low temperature magnetic fluctuation frequency at 0.4 T is about 5 MHz.**
- ➢ **Low temperature magnetic fluctuation frequency at 0.4 T is about 3 MHz.**

Conclusions

- ➢ **No long range magnetic order in both $NdNiO_2$ and $LaNiO_2$ down to 0.28 K and 0.1 K, respectively.**
- ➢ **Low temperature magnetic fluctuation frequency in $NdNiO_2$ is about 40 MHz which can not be depressed up to 0.4 T.**
- ➢ **Quasi-static magnetic order emerges near 50 K in $LaNiO_2$?**