SUPPLEMENTARY MATERIAL

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The ^{87}Sr (I= 9/2) NMR spectra of $SrTiO_3$ have been measured in a magnetic field B=9.2 T corresponding to Larmor frequency of 16.471 MHz. For NMR measurements the $SrTiO_3$ crystal was cut with two surfaces parallel to the (110) planes. The accuracy of sample orientation in the spectrometer was better than 3 degrees.

The temperature dependence of the central 1/2 ↔ -1/2 ^{87}Sr NMR transition at B || [111] is shown in Fig. 1. At the cubic-tetragonal ferroelastic transition, $T_A \approx 105$ K, where alternations in the rotation directions of the oxygen octahedra in adjacent unit cells occur, the ^{87}Sr NMR line starts to shift. As at this orientation, resonances of all tetragonal domains coincide, there has to be a single NMR line, as is indeed seen between 105 K and ~80 K.

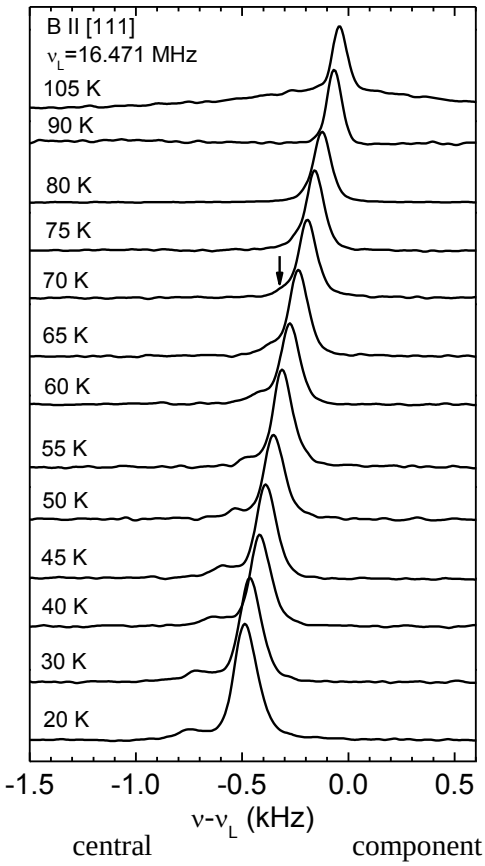

Fig. 1. Temperature dependence of ^{87}Sr NMR spectra of $SrTiO_3$ at crystal orientation B || [111]. The arrow shows the appearance of additional component in the Sr NMR spectrum at $T < 75$ K.

Below about 80 K, the ^{87}Sr NMR line broadens on its left tail and then splits at 60 K, demonstrating the existence of a two-component state. This splitting increases at lower temperatures and is well seen at $T < 45$ K.

Data fit to three Gaussian profiles, as shown in Fig. 2, illustrate the decomposition of NMR line into two additional satellite lines. Note that the satellites cannot be related to possible misalignment of the crystal orientation because in the case of misalignment all three spectral components should be of approximately equal intensity. The more intense central component still exhibits tetragonal symmetry of ferroelastic domains whereas the additional two weaker components exhibit non-tetragonal symmetry. The satellite lines

appear due to local rhombohedral distortions of tetragonal lattice similarly as it takes place in O-18 enriched $SrTiO_3$ [R. Blinc et al., PRL 94, 147601 (2005)]. The superposition of the rhombohedral distortions on the tetragonally deformed lattice will result in a triclinic symmetry of local regions of crystal. The temperature evolution of the central line (filled circle) and two satellite lines (triangles) is depicted in Fig. 3 and in the inset of Fig. 4 in the manuscript.

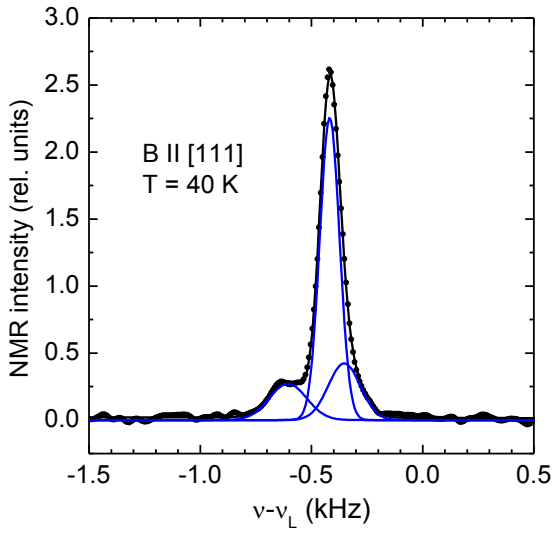

Fig. 2. Gaussian fits (solid lines) to the ^{87}Sr NMR line (points) measured at T = 40 K and **B** || [111].

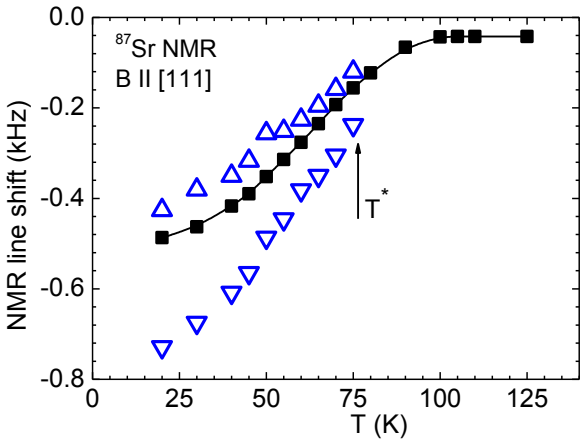

Fig. 3. Temperature dependence of the frequency shift of the ^{87}Sr 1/2 ↔ -1/2 central transition. The spectrum is split into three components at $T < T^* \approx$ 75-80 K.